IN THE

District Court of the United States

FOR THE

Northern District of California

Second Division

SPRING VALLEY WATER COMPANY, Complainant, vs. CITY AND COUNTY OF SAN FRANCISCO, Et Al., Defendants.	Nos. 14,735, 14,892, 15,131, 15,344, 15,569, Circuit Court of U. S., Ninth Judicial Circuit, Northern District of California, and 26 and 96 District Court of U. S. Northern District of California, Second Division.

ORAL ARGUMENT

OF EDWARD J. McCUTCHEN, WARREN OLNEY, JR., AND A. CRAWFORD GREENE, FOR COMPLAINANT, BEFORE HONORABLE H. M. WRIGHT, STANDING MASTER IN CHANCERY

VOLUME II.

SAN FRANCISCO HISTORY ROOM

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RESERVOIR LANDS.

MR. OLNEY: Your Honor, the subject I have to discuss is the market value of the lands composing the reservoir sites of the Spring Valley Water Company.

It is manifestly not easy, even in the simplest case, to ascertain with really positive certainty what is the market value of anything which is not made up of homogeneous units or quantities which are the subject of daily bargaining and sale.

We can ascertain very certainly the market value of a certain lot of wheat on a certain day, because it is homogeneous and is the subject of daily bargaining and sale.

On the other hand, we cannot ascertain with any such certainty and precision the market value of a certain horse on a certain day, and to the extent to which the horse has strong individual traits or qualities which distinguish it from other horses and which add to its value, the difficulty of accurate appraisement is increased. The market value of an ordinary horse, of average age and size, will be between certain fairly well ascertainable limits, which are the going prices for such horses. The case, however, of a horse that has peculiarly valuable traits, such as great speed, which distinguish it from other horses, is one where it is much more difficult to fix the real market value, and the difficulty increases with the extent to which such a horse is distinguished from other horses. It is perfectly plain that its market value is very much greater than that of an ordinary horse, but just what that market value is it is difficult to say. A "Maud S" has a market value many times greater than that of an ordinary dray horse, but the market value of the latter can be much more easily ascertained.

Exactly the same thing is true of land. While each piece of land has its own peculiarity, and therefore cannot be valued with the same certainty with which we would value a lot of wheat, nevertheless where the value of the particular piece of land depends on characteristics which it has in common with other lands, such as its availability to raise crops, its desirability for residence

purposes, etc., then inasmuch as it is in these very respects in competition with other lands and it and they are both the subject of barter and sale, the difficulty of an accurate appraisement is the least.

But when the subject of inquiry, the land or the horse, has peculiar charactertistics which are of value and in regard to which it has no or very little rivalry, then it is difficult to find a standard of comparison and the difficulty of a certain appraisement is great.

It is difficult to appraise a "Maud S" with accuracy. She is one horse in a generation of horses. What is she worth? We know that she is worth a very high figure, but just what it is, is very difficult to say.

The same thing holds true with land peculiarly adapted for some use of great importance to a community, such, for instance, as its use for railroad purposes or for water supply purposes, or for shipping purposes. In such a case an accurate appraisement is difficult, even where the land is not yet put to use, as, for instance, for a railroad terminal or for a reservoir in connection with some large city. It is even more difficult when the land has been put to such use for years and has been withdrawn from barter and sale and from contemplation as the subject of barter or sale.

The result of this difficulty is that frequently it has been attempted to get at a so-called value for such lands, where the same have been acquired by some public utility company and put to a public use, by estimating as well as possible what it would cost the company to reacquire the property, assuming that it were to be repurchased, either in the parcels in which it was originally acquired or else in parcels such as the land would be naturally divided into if it had not been put to a public use. It is usually done by valuing the land without regard to its suitability for the particular purpose for which it is used, which suitability is probably the most important element in its market value, and then applying the multiple which, according to the

experience of the witness, has represented the actual cost of acquisition in similar cases.

Even as a method of getting at the reproduction cost, as distinguished from value, this method is open to some question.

But in the Minnesota Rate Cases it was apparently thrown out entirely and it was held that in the case of land the only thing to be considered was its value, meaning by that its market value.

The plaintiff in this case has proceeded upon this principle. The testimony of its witnesses as to the value of reservoir lands has been as to their market value, that is, what could be obtained for such lands assuming that they were owned, as they are owned, not in parcels by separate owners, but in one ownership, and assuming also that they were not as yet actually devoted to a public use, that is, that they were open for sale in the market.

That this latter assumption, for the purposes of valuation, is a correct one, has already been ruled by your Honor. The matter came up in connection with the Merced lands.

Preliminary to a consideration of the testimony of the witnesses there are four points to which I desire to call attention in connection with this matter of the difficulty of making a certain appraisement of the market value of reservoir lands.

My discussion of this matter of the difficulty of making such an appraisement, which must seem not merely elementary but obvious, has been for the purpose of making these points perfectly clear in advance. These points are:

First: In determining the market value of property which is both peculiarly adapted and peculiarly desirable for some public use, the fact of such adaptability and desirability must be taken into consideration in determining its market value. This is perfectly obvious, and yet it seems sometimes to be lost sight of. It does not mean that the market value of such a piece of land is the value which it may have for the particular public use for which it is so peculiarly suited and desired; its market value may approach that value or it may not. If the particular tract of land is the only one practically available for such use and

that use is one essential to an important community, such as the supplying of water or light or power or transportation facilities to a great city, and the necessity for its use is immediate and pressing, and there is a general recognition of its suitability for the use in question and of the immediate necessity for its being so used, its market value will tend to approximate its value for such use. On the other hand, even if the property be peculiarly suited physically for some public use, as for a large reservoir, and yet there is no necessity for its immediate utilization, or perhaps it is uncertain when, if ever, it will be required, as, for instance, some reservoir site in the remote mountains, or if there be other properties which will serve the purpose as well, or nearly as well, and which can be easily had, then the suitability of the property for the particular purpose will play but a small part in determining its market value and that value will approximate its value for the other uses to which the land may be put.

The question of market value is, in its final essence, a psychological one, a question of mental attitude on the part of possible buyers. What is, or what would be, the mental attitude of possible buyers toward the property, or what would they be willing to pay? It frequently happens that the market value of property differs much from what we may call its intrinsic value, that is, the value upon which the property, if put to use, will yield a fair return averaged over a long period of time. In boom times the market price is above this; in times of depression it is below. But for the purpose of valuation at any particular time it is, of course, the market value that governs; the figure at which the property could be transmuted into money or its equivalent.

The point of the discussion is that in getting at this figure, it is necessary to consider every use for which the property may be suitable, including any public use, and, in case it is suitable for a public use, giving to such suitability in each particular case the weight and effect which it may reasonably be expected to have in the minds of possible buyers under the particular circumstances in the way of influencing their judgment as to the price which

they may be willing to pay. This is the decision of the United States Supreme Court in Boom Co. v. Patterson, 98 U. S. 403; 25 L. ed. 206, with which your Honor is thoroughly familiar.

In the present case, with the exception of Mr. Dillman, not one of the defendant's witnesses, in valuing the water company's reservoir lands, took into consideration the suitability or desirability of those lands for use for reservoir purposes. Their appraisements were avowedly made upon the basis of omitting any element of value they might have in this respect. As for Mr. Dillman, while he did, in making his appraisement of reservoir lands, take this element into consideration, yet a reading of his testimony shows beyond any question that he was not testifying as to what was in his opinion the market value of the reservoir lands of the water company, but as to a very different thing, viz: what, in his opinion, ought in fairness, as fairness is judged by him, be allowed the water company on account of such lands.

The only testimony as to the true market value of the company's reservoir lands, their market value as determined by all the factors of value which they have, is that of the plaintiff's witnesses, Grunsky and Cory.

It may be said that the plaintiff itself put in testimony as to the value of the Calaveras, San Antonio, Arroyo Valle and Lake Merced reservoir lands, which omitted the element of their desirability for reservoir purposes. This is true. It may also be said that plaintiff's witnesses, in valuing its water-shed lands, omitted any consideration of their availability for water-supply purposes, although manifestly, in many instances, if not in most, they are more valuable for that purpose than for any other. This, also, is true. The reason for such testimony, and its bearing, I desire to discuss in connection with the third point.

The second point I desire to call to your Honor's attention is that while it may be difficult, in the case of lands peculiarly suitable and actually needed for some public use, particularly when such lands have already been put to such use, to fix with accuracy their market value, because of the very fact of their

peculiarity, yet there can be no reasonable question but that this peculiar suitability, coupled with the need for lands having just this suitability, gives the lands a higher market value than they would otherwise have. This is nothing more than saying that, in general, where land is peculiarly suited for a public use such use is the highest or most valuable use to which it can be put and that the market value must be determined with reference to such use.

The extent to which any particular tract of land, suitable, for instance, for a reservoir site, will be increased in market value by reason of that peculiarity will vary according as the need for its use is both immediate and great. If there are other lands which will serve the purpose as well, or nearly as well, or if there is no prospect of the particular land being required for public use in the comparatively near future, the market value will be very slightly, and perhaps not at all, affected. Take the case of Mr. Dillman's ranch in Shasta County, which he says is a valley admirably suited for a reservoir and which he says, nevertheless, he is ready to sell for its fair value for agricultural or grazing purposes. I haven't any doubt this is true, but Mr. Dillman's ranch is remote and the possibility of its ever being required for a reservoir is very slight. Under such circumstances its market value is, of course, very little, if any, above what it would bring for agricultural or grazing purposes. Yet I warrant that Mr. Dillman was a little more willing to purchase the property, and would now be a little more loth to part with it, because of its peculiarity in this respect, even though the contingency of its being used as a reservoir is so slight.

On the other hand the peninsula reservoirs of the Spring Valley Water Company are at the other end of the scale. They are in close proximity to a great city. They are practically the only available sites close to the city for large reserve and storage reservoirs. The advantage to a city of such reservoirs, in close proximity, is very great in any case. In the case of San Francisco, by reason of earthquakes and the particular danger of interruption of service to which it is subject if it relies upon long

conduits, such reservoirs close to the city are an imperative necessity. Not only is this true in fact, but the fact is well and generally recognized. If these peninsula sites were not occupied by reservoirs at the present time, there can be no question but that there would be an immediate and imperative demand for them for that purpose.

This demand would certainly substantially increase their value in the minds of possible purchasers. If, for instance, the Crystal Springs dam were not yet built but all the reservoir lands, together with the dam site, were in the ownership of one individual and open to sale and purchase, would there be any question about the market value being far in excess of their agricultural or residence value? There can be no doubt that in such a case purchasers would be found who would be ready and willing to pay a price far in excess of any value which these lands may have for agricultural or grazing or suburban purposes.

It may be difficult to put an exact figure on a market price which is influenced or made by such considerations, but that such lands as those comprised in the peninsula reservoirs have a high market value hardly admits of question. All of this seems to be quite self-evident. I dwell on it because, apparently, the only purpose of introducing the testimony of Messrs. Bayley and Martin on behalf of the city was to show that although a particular tract of land may be suited for a reservoir and may be immediately and imperatively demanded for that purpose, its market value is not thereby increased.

The sum and substance of the testimony of Bayley and Martin is that in purchasing reservoir sites for the Los Angeles aqueduct system they had paid no more than the agricultural or residence value of the land. Now the only possible bearing that such testimony can have on the present case is that it is sought therefrom to draw the inference and to establish the proposition that lands which are suitable for reservoir purposes for the supply of a great city, and are immediately desired for that purpose, are not thereby affected as to their market value.

It is perfectly plain, however, and we know that such inference cannot be true. If lands suitable for reservoir purposes in connection with the Los Angeles aqueduct, and imperatively demanded for that purpose, were in fact purchased for no more than they were worth for general purposes, we know that the lands were purchased for less than the figures that the owners could have obtained if they had insisted upon obtaining the highest figure to which they were entitled. If any instances are needed on the other side the tabulated costs of acquiring watershed and reservoir lands in Mr. Grunsky's report are sufficient. The city Hetch Hetchy purchases are another instance.

Mr. Mulholland's testimony shows the real situation clearly enough (11066-11080). The facts are that the reservoir sites were not peculiarly adapted for that purpose and there was no imperative necessity for their use. I refer to the sites concerning which Messrs. Bayley and Martin testified. The reservoir sites were not first-class reservoir sites (11072-11073). There was no necessity for using these particular sites. There were others just as good. In fact, in the case of the Franklin Canon reservoir there was another site which Mr. Mulholland would have preferred—that in Weid Canon—and the only reason for taking the Franklin site was that the condition of the title to the Weid Canon site was such as to make its acquisition difficult without a condemnation suit (11069).

In addition to this there were in at least two cases the special circumstance that the construction of the reservoir on the site desired would greatly benefit the owner of the site because the owner had other lands which would be largely increased in value thereby. The result was that in the case of the San Fernando reservoir the owners donated part of the land and sold part at what Mr. Mulholland said was the nominal price of $75 an acre (11068).

The Benedict reservoir site was situated just a mile west of the Franklin Canon site and was offered to the city for nothing, because the owners had a large tract of land in the vicinity whose

value would have been increased if the reservoir had been located there (11070-11071).

In the case of the Franklin Canon site there was the additional circumstance that there was an option out on the property held by two men, one of whom was a member of the Advisory Board of the Los Angeles aqueduct, and the city simply purchased this option (11069-11070).

Summing the matter up, so far as Bayley and Martin are concerned, the only point which their testimony can have is to draw the inference from it that the availability of lands for reservoir purposes, and the necessity of their being used for that purpose, does not increase their market value. The particular circumstances connected with the acquistion of the sites concerning which they testified show that no such inference is to be drawn. Such inference was, furthermore, manifestly untrue on general principles. I submit, accordingly, that the testimony of these two gentlemen is without bearing on this case and I shall not discuss their testimony further.

The third point I desire to make is that while it is difficult, if not impossible, to appraise with certainty the exact market value of lands adapted to some particular use, essential and of great advantage to the community, so that those lands have a unique character, yet it is possible for a witness acquainted with the situation to fix a minimum figure which he can say with safety is at least the market price.

The analogy of a horse of exceptional and unique qualities still applies. Take "Maud S" for example. Her market price in her prime may have been $100,000 or $150,000. It may well be that it was not possible for anyone, no matter how well acquainted with fine horses and their value, to say that either sum was her market value. But even one whose information consisted simply in the general knowledge which he got from reading the newspapers would know that she would bring at least $5,000, in fact he would be morally certain that she would bring at least $25,000. An expert could carry this much further. To the extent to which

he has particular knowledge the realm of uncertainty is as to him removed and he can fix a higher figure as that which at least she would bring. He might be able to say, for instance, and to say with reasonable certainty, that she would sell for at least $50,000, that she might bring very much more, but that she would bring at least this.

Exactly the same thing is true of lands of the character we are describing. We, ourselves, would know, for instance, that the peninsula reservoir lands, aggregating some 2,000 acres, are worth more than $100,000; we would know that without any evidence as to their market value simply from our own general knowledge. We would know, in fact, that they were worth at least $200,000; and when we know more about them and about the value of lands in general on the peninsula, and about the necessity for the use of these particular lands for supplying San Francisco with water, and about the needs of the peninsula itself for water, and about all the other matters which enter into their market value, we can push our minimum still farther up.

In passing I take the liberty of saying that if Mr. Dillman's figures on the peninsula reservoir lands are to be taken as figures on market values they seem to me ridiculous on their face, in view of what we all know of the exceptional character of the lands, the absolute necessity for their use in supplying the city, their history, the general recognition of their character and of the necessity for using them, the previous public appraisements which have been made of them, the appraisement in the Drinkhouse case, the appraisement of the City Engineer, the appraisement by Judge Farrington.

On the 28 acres in the Pilarcitos site Mr. Dillman puts a value of only $1260 (6498). This reservoir has a capacity of over a thousand million gallons and a yield per acre of 27,500 gallons per day or 3,000,000 gallons daily. (Table 11, p. 1248.) Is it possible that lands, the potential site of a reservoir of such capacity and yield, in close proximity to the City of San Francisco, and at a high elevation, are worth only $1260?

On 442 acres, which he takes as the area of the San Andreas reservoir lands, Mr. Dillman places a figure of $88,400. This reservoir has a storage capacity of over six thousand million gallons and a yield per acre of twelve thousand gallons per day or six million gallons daily (Table 11, p. 1248). Is it possible that if a man owned these lands to-day, in one body, available for immediate use as a reservoir, their fair market value would be only $88,400?

On the 1474 acres which Mr. Dillman takes as the area of the reservoir lands in Crystal Springs, he puts a value of $471,680. This reservoir has a storage capacity of 22,360,000,000 gallons and a yield per acre of 6030 gallons per day, or 9,000,000 gallons daily. Take all of the Crystal Springs reservoir lands and assume that some one individual owns them all, is it possible that he would not be able to sell them for far in excess of $470,000? Mr. Dillman's total figure for the lands in all three peninsula reservoirs is only $561,340.

Suppose these three reservoir sites had been lying there unused on the 31st day of December, 1913, and owned by one individual—is it not certain from what we ourselves know as to the character of these sites and the necessity for their use, and the general recognition of this character and necessity, that anyone owning them could sell them without difficulty for far in excess of this figure? The fact of the matter is that Mr. Dillman was not testifying as to market value at all.

My comment on Mr. Dillman's figures has been in the nature of a digression. The point is that while a witness cannot in the case of lands of the unique character of the lands in these peninsula reservoirs fix their market price with certainty, he can fix a price which in his judgment is the least figure which can be put upon them, and that the better acquainted he is with the property and the various factors entering into its valuation the higher will be the minimum; that is, the less will be the realm of uncertainty as to him.

The testimony by Mr. Grunsky and Mr. Cory is to this minimum figure. They did not attempt to fix the market value absolutely, what they did was to say that, taking everything into consideration, they were certain that it was worth at least so much. This they could do with a reasonable degree of certainty and reliability.

Finally, in connection with this point that while it may be difficult or impossible to fix with accuracy the market value of reservoir lands, it is possible for a thoroughly qualified witness to fix a minimum which he knows the market price will equal or exceed, I wish to consider the bearing of testimony as to market value which omits from consideration their value for water supply purposes. It is evident at once that the value so obtained is a minimum; to the extent to which the suitability of the land for water supply purposes affects its value the effect will be to increase the value. Furthermore, in those cases where the necessity for using the land for water supply purposes is not immediate, or where it is possible that they may never be used, or where it is possible to get along without the property without any very great inconvenience or disadvantage, the actual market price, that is, the price for which the property would sell with all its capabilities taken into consideration, including that of its capability of being used for water supply purposes, has a relation to its value for general purposes solely and is not so very far from it. In such cases, accordingly, testimony as to its market value for general purposes only, omitting any consideartion of its value for water supply purposes, is of significance and of some assistance.

Perhaps the best example of this in the present case is that of the watershed lands. There can be no question that, by reason of their usefulness for water supply purposes, these lands have, in general, a value in excess of what they would have if they did not have this attribute. But the witnesses on both sides valued them without regard to this. The reason was that their true value would not much exceed this and it would be exceedingly difficult to get at the matter in any other way.

In general, any particular piece of watershed land is not absolutely essential. It is possible to get along without it. It should be noted, however, that this means that to some slight extent the watershed lands have been generally under-valued, and I think it is fair to ask your Honor, in placing the value upon those lands in this case to bear in mind that the valuations placed upon them have, as a matter of fact, omitted from consideration an element of value which they undoubtedly have.

The same thing applies, though not so strongly, to the San Antonio and Arroyo Valle reservoir sites. Those sites have not been put to use as yet. It is not certain just when they will be. Under these circumstances the frame of mind of anyone owning them and desiring to dispose of them, and the frame of mind of anyone considering their purchase, would be that he would sell or buy upon the basis of their value for general purposes, that is, in these cases, for agricultural and grazing purposes, with something in addition because of the speculative element of value which they have by reason of their adaptability and probable requirement sometime for reservoir purposes.

On the other end of the scale are the peninsula reservoir lands. These lands are admirably adapted for reservoir purposes. They are unique in that there are no other lands close to San Francisco which can compare with them in this respect and that the necessity for their use is immediate and imperative, and that all of these facts are thoroughly well recognized and would be present in the mind of any possible buyer in case the lands were available for sale. It is evident that in such a case the market value of the lands for general purposes, that is, for agricultural, grazing, or suburban residences, which omits the consideration of their value for the highest purpose to which they can be put, is of practically no significance. The plaintiff, accordingly, as to these particular reservoir lands, put in no evidence of this character. The defendants' testimony, on the other hand, with the exception of that of Mr. Dillman, was all of this character. I submit that such testimony should be disregarded, as avowedly omitting from con-

sideration the most important element of value which the land possesses.

The fourth point I desire to make is that this difficulty of which I have been speaking makes more important the familiarity of the witness with all the factors which enter into the case. Assuming that their qualities in other respects are the same, it is impossible for a witness who has had but a short acquaintance with the property to acquire the same certainty of judgment and reliability that a witness would have who had been familiar with them, familiar with their history, and familiar for years with the general problem of the water supply of the communities about the Bay of San Francisco. In this respect we think that the two witnesses on behalf of the plaintiff are peculiarly qualified.

There is no one outside of those who have been in the employ of the water company, and whose testimony might, for that reason, be somewhat doubted, whose testimony is entitled to as much weight as that of Mr. Grunsky. He has had a long and honorable career as an engineer. He has had an acquaintance with the properties on the peninsula since 1886, when he was employed by the water company in connection with the acquisition of some lands which included a portion of the dam site of Crystal Springs reservoir (1206). A few years later he was a witness against the company in the Drinkhouse case, wherein the company was seeking to condemn some of the Crystal Springs reservoir lands. Later, for several years, he was City Engineer of San Francisco, and as a part of his duties he was required to appraise, and did appraise, these very lands. He is thoroughly familiar with the properties; he is thoroughly familiar with their history; he is thoroughly familiar with the relation of the properties to the matter of water supply for San Francisco and the communities about the bay; and he is thoroughly familiar with the public point of view toward these properties. This familiarity covers the property on both sides of the bay.

Mr. Cory was particularly familiar with the lands on the east

side of the bay, to which his testimony was confined. In the course of his employment by east bay water companies he had made a very complete examination of reservoir sites in Alameda County. He had acted for the Union Water Company, and afterwards for the Reorganization Committee of the Peoples Water Company. In that connection he had considered and valued the existing reservoir sites at Lake Chabot, and Temescal, and possible sites at upper San Leandro, San Pablo, Pinole, and Wildcat, and had familiarized himself with the reservoir properties of the Spring Valley Water Company on that side of the bay.

Both these witnesses, as I have said, testified strictly to the market value of the reservoir lands of the company. They are the only witnesses who did so testify. I make this statement having in mind the testimony of Mr. Dillman, which I intend to discuss later and which I am certain will appear not to have been testimony as to market value at all. In other words, the situation is that the testimony of Mr. Grunsky and Mr. Cory is practically uncontradicted. This, of course, does not mean that it is necessarily to be accepted without question. It does mean, however, in view of the fact that the defendants in this case have had every opportunity to produce testimony to the contrary, that it is to be presumed that such testimony could not be obtained, and unless the testimony of Mr. Grunsky and Mr. Cory appears to be intrinsically unsound it should be accepted.

Coming now to a particular discussion of the testimony itself, I think no better demonstration of Mr. Grunsky's grasp of the problem which confronted him can be made than by quoting his own statement of it and of the factors which he considered should be considered as properly entering into its solution. Beginning on page 1209 of the transcript, I read from his testimony as follows:

"There is no recognized rule for determining the market value of a property which is adapted to some especial use, such as that of a reservoir which makes possible the development of a water

supply or which is necessary to hold waters in reserve, for use in the case of an emergency, such as may arise when the ordinary supply is temporarily not available.

"No other course is open in ascertaining the market value of such reservoir sites than to determine the effect upon the market of a knowledge of all the circumstances bearing upon each case. This is particularly true when as in the present case some of the reservoir sites whose values are to be determined are the only ones of their character which are available for the particular purpose which they fulfill.

"If the necessity to use the property is an immediate one it may be proper to determine an upper limit of value by comparison with the next most available source of supply; but this limit is not market value, though it may be the measure of what the party desiring to use the property can afford to pay. There should always be a margain in favor of the party who actually uses the property for the purpose to which it is specially adapted.

"Ordinarily when the value of land is to be determined the return which it produces in rents or otherwise, or which may reasonably be anticipated, and the sales of other similarly located property adapted to similar uses, can be used as an index of its market value. But in the case of land which is in use or that available for use as a storage reservoir, there is usually no such standard of value that can be applied. It would be an unusual circumstance to find sales of recent date of similar property that would with any definiteness demonstrate value. Neither is the rental value of such property, for the use to which it has special adaptability, ascertainable even when already in use, because this is a special use generally more or less monopolistic in character. A reservoir may be a material factor in making possible certain net earnings resulting from the sale of water, but even when these net earnings can be ascertained with definiteness there will be much uncertainty in the matter of determining what part

thereof should be assumed to result from the use of the reservoir land.

"Nevertheless there are many circumstances which will have an effect upon the market value of reservoir properties, such as for example the time when the use of the site will be a necessity, and the time when the water supply commanded by the reservoir will be in full use; the availability of other equivalent storage sites or other equivalent sources of water; the location and all circumstances affecting cost of developing the storage and of effecting a delivery of the water, particularly when the reservoir site is not yet in use nor immediately requisite; also the extent to which the availability of any particular site has been demonstrated, and every circumstance relating to valuations that have been made by competent authority of the properties under consideration for rate fixing or for other purposes.

"In the case of the reservoir sites now owned by the Spring Valley Water Company, consideration must be given,—

"To the adaptability of the land for use as a reservoir site.

"To the necessity of such use and the continuance thereof.

"To the fact that the reservoir lands have been assembled at each site in one holding.

"To the fact that in the case of the Peninsula reservoirs the adaptability of the several reservoir sites for use as reservoirs has been demonstrated by actual use.

"To the cost of the lands and the increase of their value since the time of purchase.

"To the valuations placed upon the reservoir lands by San Francisco for rate fixing purposes.

"To the valuation as judicially determined in the rate case of 1903.

"To the fact that San Francisco has declared the Peninsula reservoirs and Lake Merced necessary as a part of its ultimate water supply system.

"To the fact that there are no other sites for water storage

in large amount, near at hand, that could be used in place of the Peninsula reservoirs.

"To the proximity of the reservoir sites to population centers and to regions in which population is increasing rapidly.

"None of these factors taken separately leads to a determination of value which can be accepted without question. All of them should be brought under review. It is the consideration of all these factors which would influence a willing seller and a prudent purchaser in reaching conclusions relating to market value; and it is by such consideration that the values herein set forth have been determined."

Mr. Grunsky then goes on to consider all of these various factors which he has mentioned and then sums up in the following language, which I quote because it shows so clearly just what he was doing (1235):

"In reaching conclusions as herein presented relating to the market value of reservoir properties the circumstances have been weighed which would affect an intelligent public or a prudent purchaser in determining market value. The seller of such properties, as well as the purchaser, would give consideration to every known fact relating thereto. Both would be influenced more or less in their conclusions by the various circumstances to which I have called attention, and both would give consideration to the effect of all these circumstances upon the minds of an intelligent public, because it is this effect and the resulting attitude of the public which is the main factor that influences market value."

In the case of the Peninsula reservoir lands Mr. Grunsky's conclusion is that at the end of the year 1913 those actually in use had a market value of at least $1400 per acre, while the higher lying lands at the Crystal Springs reservoir, which will ultimately be included in it, had a market value of at least $700 per acre.

The conservative nature of this valuation on Mr. Grunsky's part is made manifest in several different ways. He himself, when acting for the city in 1901, valued the same lands at $1250 an

acre. Mr. Grunsky finds from an examination of the assessment rolls and U. S. Census Reports that in San Mateo county lands have increased in value at the rate of about 7 per cent per annum. Applying a rate of increase of 5 per cent only to the valuation of $1250 which Mr. Grunsky made in 1901 would give him a valuation of about $2000 an acre in 1913.

A factor considered by Mr. Grunsky, and one deservedly of great importance because of its necessary effect upon the public mind, was Judge Farrington's valuation as of 1903. This was $1000 an acre. Applying a 5 per cent per annum rate of appreciation would give as the value of these lands in 1913 about $1750 an acre.

Mr. Grunsky, as one of the matters which he took into consideration in reaching his result, determined, as approximately as possible, what was the actual cost of these reservoir lands to the company at the time they were acquired and, assuming this to have been their actual value at that time added an annual appreciation of 5 per cent to see what the result would be, and found that in 1913 it gave him a value of about $1750 an acre. Nevertheless, because he was testifying, not to what he thought was most probably the market value of these lands, but because he was testifying to a minimum figure which he could be reasonably certain that the market value would at least equal, his final figure is but $1400 an acre.

The conservative nature of Mr. Grunsky's judgment is also shown in the case of Lake Merced. He points out its necessity to the city as an emergency reservoir and its present very great usefulness in connection with the city's supply, and states that, considering these things alone, the value per acre of Lake Merced itself should not be greatly at variance with that of the Peninsula reservoir sites; but he says that very shortly the use of Lake Merced for any but emergency purposes must be abandoned, and, although it is apparent that this emergency use is of the greatest importance to the city and is something that the city could

not afford to sacrifice for almost any amount of money, he places as the minimum for its market value $1000 an acre, or $336,000 in all. This figure may be compared with that of Mr. McDuffie, who after considering carefully the enhanced value which would result to the lands about the lake, if the lake were included with them, places the figure at $442,800 (3104-3107). In other words, Mr. McDuffiie's figure is over $100,000 greater than Mr. Grunsky's.

The same conservativeness is evident in connection with the Calaveras. He points out the exceptional character of this reservoir. The water surface of the completed reservoir will be at an elevation of 790 feet. Its 1930 acres will have a storage capacity of 46 thousand million gallons, while the 2100 acres in the whole Peninsula system have a storage capacity of less than thirty thousand million gallons.

MR. GREENE: Those figures are incorrect, Mr. Olney.

MR. OLNEY: I have taken them from Mr. Grunsky's table.

MR. GREENE: But that table has been corrected. That 46,000 million gallons should be 55,000 million gallons.

THE MASTER: We will let it stand just as you have stated it, Mr. Olney, and that will show a correction in the transcript.

MR. OLNEY: Very well, your Honor.

It will have a storage capacity per acre of twenty-four million gallons as against an average capacity for the Peninsula reservoir of fourteen million gallons per acre. It will have a yield per acre of about nineteen thousand gallons per day as against eighty-five hundred for the Peninsula system. (1233, 1234 and Table 12 on p. 1249.)

He points out, also, that the availability of the site and the possibility of erecting a high dam there had long been recognized and was generally accepted as sufficiently demonstrated in 1913. He says it was also known at that time that both the east bay region as well as San Francisco were in need of more water than was available for delivery. He says, however, that although this was the situation, there could have been no assurance given to

an outside owner, assuming that there was such of the Calaveras reservoir site in 1913, that it would be immediately utilized. He also gives consideration to the fact that at that time, by an early development of other sources of supply, such as those of San Antonio and Del Valle creeks, the Calaveras supply could be deferred for a number of years. He concludes that under these circumstances the Calaveras reservoir lands cannot have a value greatly in excess of the value of similar lands not available for reservoir purposes. He is certain, nevertheless, that there was an excess value and states his judgment to be that in view of all the circumstances, the Calaveras reservoir lands had at the end of 1913 a market value of at least $200 an acre, or a total of $384,000 in all.

When we consider the history of the Calaveras site, the general recognition of the fact that it is the best reservoir site on either side of the bay, that there was a necessity on both sides of the bay for a large further development of water supply, and that the Calaveras reservoir offered by far the most available means for this, if we assume that the whole reservoir site was held by one individual, who was free to hold it or to sell it, it is quite evident that Mr. Grunsky's value of $384,000 is an exceedingly conservative value.

He does not endeavor to put a specific figure on either the San Antonio or the Arroyo Valle sites. After considering the factors which enter into the problem of their market value, he says simply that they had a market value in 1913 of at least 25 per cent over the value which they had for agricultural and grazing purposes.

In the case of the San Antonio this 25 per cent amounts, on the basis of Mr. Gale's and Mr. Schween's valuations to be about $9000, and on the basis of Mr. Callaghan's valuation to about $5000. In the case of the Arroyo Valle it amounts, on the basis of Mr. Gale's and Mr. Schween's valuations, to about $4000, and on the basis of Mr. Callaghan's valuation to about $2000.

When it is considered that both of these sites are recognized as available and valuable reservoir sites, fairly certain sooner or later to come into use, and that the San Antonio is a part of the city's Hetch Hetchy scheme, it is perfectly evident that Mr. Grunsky's estimate of from $5000 to $9000 in the case of the San Antonio, and from $2000 to $4000 in the case of the Arroyo Valle, as the increase in market value which those lands would have, attributable to their value for reservoir purposes over and above their value for agricultural and grazing purposes, is extremely conservative.

There is one portion of Mr. Grunsky's testimony which I think has been misapprehended. Apparently it has been thought that Mr. Grunsky proceeded upon the theory that, in general, reservoir lands, as compared with adjoining watershed lands, were worth in the ratio of about ten to one. Mr. Grunsky did nothing of the sort. It is, of course, perfectly evident that he did not do this with regard to either the Calaveras, the San Antonio, the Arroyo Valle, or the Lake Merced reservoir lands. So far as Lake Merced is concerned, his valuation is much lower than the adjoining lands. His ten to one ratio was used by him only in connection with the Peninsula reservoir lands and as to those lands had relation only to one factor connected with them, viz: their original cost. What Mr. Grunsky actually did was this:

He assumed, and the justification for his assumption is manifest, that the original cost of the reservoir lands represented on the average approximately the market value at the time of purchase of the various parcels purchased. He then sought to ascertain the average cost per acre of these lands. It was in connection with ascertaining this cost and in this connection only that he used the ten to one ratio. Having approximated the cost and assuming that this was the then market value of the lands, he next sought to ascertain what had been the general increase in value of lands of the same general character in San Mateo County. An examination of the assessment rolls of the counties around the bay, and of

San Mateo County in particular, and of U. S. Census Reports, both as to increase in population and as to the increase in value of farming land, indicated an annual increase of about seven per cent (1223). Mr. Grunsky, however, was not willing to take this figure, but took five per cent instead. Applying this rate of increase to the original cost he obtained for the year 1913 the figure of $1750 an acre. Now of this process and of the figure obtained by it, Mr. Grunsky himself says:

"A study of this kind, while it is interesting and instructive, cannot be accepted as conclusive" (1224).

Nevertheless, while not conclusive, it is quite significant, and there are several things in connection with it worthy of particular note.

First, it is of very great value by way of check, or perhaps it would be better to say by way of corroboration. If a market value of $2500 an acre had been put on the Peninsula lands for 1913, and following Mr. Grunsky's method of considering original cost we should obtain a figure of only $1750 an acre, as he did, the market value of $2500 an acre, while not disproven, would not be corroborated, and we might justly feel some question about its correctness and would look for some explanation of how it was that the market value was now so much in excess of the figure obtained by taking the original cost and adding a fair rate for annual increase. But when we find, as we do in this case, Mr. Grunsky testifying that in 1913 the lowest market value which could be attributed to the lands in question was only $1400, and following his method of dealing with original cost, and following it conservatively, we get a figure of $1750, we can feel with some certainty that $1400 is a conservative low limit and that the real market value is probably greater.

Second: It is worthy of note that while Judge Farrington appraised these lands at $1000 an acre as of 1903, Mr. Grunsky, by dealing with original cost in the manner in which he has, obtains for the year 1903 a figure of $1070 an acre.

Third: While the figure arrived at by Mr. Grunsky's method may be much below or much above the real market value in any particular case, because of the possibility of special circumstances affecting the value of the particular lands under consideration, yet in the present case everything would point to the figure of $1750 which he arrives at as being below rather than above the real market value. For one thing, the rate of appreciation taken by Mr. Grunsky of 5 per cent annually is very conservative. The rate shown by the assessment rolls is 7 per cent. Perhaps even more significant than the rate shown by the assessment rolls is the rate of average growth in population of San Mateo county. It is generally recognized that in general real estate values grow quite a little faster than the growth in population—for instance, the average rate of growth in population throughout California since 1860 has been 3.7 per cent, and against this the increase in the value of farming lands has been 6.9 per cent, or nearly twice as fast (1222). The growth of population in San Mateo County during the period in question has been at the rate of 4.3 per cent per annum. From this the presumption would be that the rate of increase in lands had been at least 6 per cent as against the 5 per cent taken by Mr. Grunsky.

We know also that these particular reservoir sites are in a locality where lands have greatly increased in value

Another, and a very important consideration, is that the method of taking original cost and adding a rate of appreciation omits entirely the element of value that is due to the fact of each site being held in a single ownership. The original cost in the case of each reservoir is that of acquiring a great many parcels of land making up each site and the aggregate of the costs of these parcels is taken as the market value of the whole. But we know well enough that it is less than the market value of the whole. It is the aggregate merely of the market value of the separate parcels held in divided ownership and in the case of such property as reservoir property, whose highest use and greatest value is for

reservoir purposes, it is evident that when the whole site has been gathered into one ownership its market value as a whole is greater than the market value of the divided parcels.

Coming now to the part which the ten to one ratio played in this process of taking original cost and adding an annual rate of appreciation, the ratio was used simply in order to ascertain as well as might be done what the original cost of the Peninsula reservoir lands was. Those lands had been acquired in parcels, nearly every one, if not all, of which included more or less watershed land. There was just one price for each parcel purchased, without any segregation of this price as between reservoir and watershed lands. In order to get the cost of the reservoir lands it was necessary to make such segregation. For this purpose Mr. Grunsky desired to get the average ratio between the cost of reservoir land and that of watershed land. To do this he took certain selected tracts, which appeared to be most fairly representative, which were made up mostly of watershed lands, and also certain other selected tracts of the same character, made up mostly of reservoir lands. In the case of Crystal Springs, he found the average price for the tracts made up mostly of reservoir lands to be $380 an acre, and for the tracts made up mostly of watershed lands to be about $50 an acre. This was at a ratio of about eight to one. This ratio, of course, was smaller than the true ratio between reservoir and watershed lands, since the fact that watershed lands were included in the tracts which were taken as representing chiefly reservoir purchases reduced their average cost, and the fact that reservoir lands were included in the tracts taken as representing watershed purchases raised the average price of those lands. For the purpose of a closer approximation as to the actual cost of reservoir land as compared with watershed land, Mr. Grunsky took this ratio of eight to one and upon this basis determined, in the case of each of the selected lots, how much was paid for the watershed lands and how much for the reservoir lands, and the average for each; that is, he took his ratio of eight to one and got the specific figures with it.

MR. SEARLS: Mr. Olney, that was not his final ratio as determined afterwards.

MR. OLNEY: I am coming to his final ratio.

MR. SEARLS: I mean his final first approximation, as determined after his cross-examination; he revised those figures.

MR. OLNEY: I am coming to that, Mr. Searls.

In other words, he took this figure of 8 to 1, which represented the average of tracts on one side, which included both reservoir and watershed lands, but a larger element of reservoir lands, as compared with tracts which included both reservoir and watershed but a larger element of watershed lands, and then took that ratio and divided the properties up and got the specific prices paid for reservoir and watershed lands upon that basis.

Making this segregation in the case of the Crystal Springs he got an average price of $508 per acre for reservoir lands and $27 per acre for watershed lands, or in the ratio of about 18 to 1 (7864 to 7867. See also tables appearing on pp. 8252 to 8255). These latter tables were made up upon the basis of including in the selected tracts all of the tracts which Mr. Searls indicated by his examination he thought should have been included. Including these tracts Mr. Grunsky gets an average price of $406 for the reservoir lands and $38 for the watershed lands, or a ratio of a little over ten to one.

At San Andreas, on the other hand, the corresponding figures are $124 per acre for reservoir lands and $29 per acre for watershed lands, or a ratio of about four to one.

At the Pilarcitos, there are no available data for such a computation as that made in the case of Crystal Springs and San Andreas, but some of the purchases indicated a per acre cost of about $5 an acre for watershed land, and of course having a per-acre cost for watershed land it is possible to segregate out the cost attributable to reservoir land.

On the basis of $5 an acre for the Pilarcitos watershed land, the ratio between reservoir land and watershed land is somewhat

less than ten to one. Just what it is can be figured from Table 21, page 7880, but Mr. Grunsky does not give it. The point is that the acreages and costs in the case of Crystal Springs are so much greater than in the case of the other two combined that, while the ratios in the case of both San Andreas and Pilarcitos are less than ten to one, they are completely overcome by the ratio of Crystal Springs. As a matter of fact the ten to one ratio is lower than the average ratio for the three sites as so determined. It seems to me quite evident from a consideration of Mr. Grunsky's figures that his ratio of ten to one was, as a matter of fact, a conservative ratio basing it upon the actual prices paid.

There is a striking corroboration of Mr. Grunsky's figures in the wholly independent appraisements of watershed lands made by Baldwin and Hoag. Their average appraisement for the watershed lands purchased along with the reservoir lands, and whose probable cost Mr. Grunsky sought to segregate, was $166.50 per acre on December 31, 1913. Mr. Grunsky's figure for the average cost of this same land was $32.30 per acre. The year 1876 represents about the average time of purchase. The difference between these two figures of $166.50 per acre as of 1913 and $32.30 per acre as of 1876, spread over the intervening years, means an annual increase in value of about 4½ per cent. This, certainly, is a very conservative rate of increase. If the actual rate of increase had been greater than this, then figuring back from the valuation of $166.50 in 1913, Mr. Grunsky's figure of $32.30 in 1876 is too high. If it was too high, then the proportion between reservoir and watershed lands in 1876 was greater than ten to one. In other words, here again, if Mr. Grunsky has erred, he has erred on the conservative side. Coming now to the testimony of Mr. Cory.

Mr. Cory testified only as to the market value of the three reservoir sites on the east side of the bay. By reason of his familiarity with the water supply problem on the east side of the bay and the studies which he had made in that connection into the character and value of available reservoir sites in Alameda

County, including those which could by any possibility be considered as alternative sites by possible purchasers and as, therefore, coming in competition in the market with the sites of the Spring Valley Water Company in case those sites were up for sale, he was peculiarly qualified to form a reliable judgment as to what could have been obtained for the Spring Valley sites in the open market. Mr. Cory's testimony speaks for itself and I shall confine myself almost entirely to quoting from it. Beginning on page 1351, he says:

"It is obvious that in general the market value of any piece of real property is determined by a consideration of the highest use to which it may be put. Generally speaking, the highest use of rural lands is for agricultural purposes, and the market value is determined by that use, while the highest use of urban lands is for other than agricultural purposes, such as residences, business buildings, etc., and their market values are determined by such uses.

"Broadly speaking, almost every piece of land may be used for reservoir purposes—indeed, water storage is frequently created in level fields for use in connection with irrigation pumping plants, etc. In the majority of cases one or more essential elements are lacking to give even natural basins practical value for reservoir purposes. Such elements of importance are, sufficient watersheds behind them; precipitation satisfactory in amount and character; practicable cost of structures; sufficient market for stored water; satisfactory character of geological formation, precluding excessive leakage losses, etc. In such cases the reservoir use of land is below the agricultural or urban use.

"Since the market value of real estate is generally determined by its highest use, it follows that the absolute minimum market value of rural reservoir possibilities is the agricultural value, and of urban reservoir sites the residential or commercial values. In some cases they may govern.

"Otherwise, agricultural, residence or commercial urban uses

are lower than the use for collecting, storing, or distributing water. In these cases the absolute maximum price which can be paid for these lands is measured by the return which can be secured from a project of which they are an essential part, together with the costs of all other elements of the system.

"With reservoir lands, therefore, there are two limits—sometimes widely apart; the minimum being the value for agricultural or urban uses, the maximum being what the traffic will bear. At any given time the market value of such lands will be somewhere between the two extremes. With indifferent reservoir possibilities, the market values will closely approximate the lower limit; with excellent reservoir sites, when there are no alternatives, they will tend more toward the higher limit.

"So many factors are involved that each particular reservoir or system of reservoirs must needs be considered separately. This will be done with each of the several reservoirs under consideration:

"Calaveras Reservoir: On December 31, 1913, it was, and had been for nearly thirty years, a matter of common knowledge that the Calaveras reservoir was an important factor in the water supply situation of the San Francisco Bay region. It had been brought before the public mind through the reports of T. R. Scowden, Colonel Mendel, and others, as early as 1874."

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"It was known that several examinations of the reservoir site had been made, and that it had been found to be geologically water tight; to have an excellent dam site; and to have a watershed with a precipitation insuring a large run-off."

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"On December 31, 1913, the Peoples Water Company, on the east side of the bay, had just passed through a very severe drought, and by the narrowest possible margin escaped a water shortage disastrous not only to it, but to all the east bay communities."

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"The Union Water Company, which had aspired to be a com-

petitor of the Peoples Water Company, had just abandoned its endeavors to develop enough underground water along the eastern bay coast to become an important factor in the water situation in the bay cities. A great deal of work had been done and plans were well advanced for bringing to a vote in the east bay cities the creation of a municipal water district. The requirements of the Spring Valley Water Company had reached its developed water supply.

"In short, there certainly would have been at least three water companies and two sets of individuals deeply interested in, and perhaps even officially representing, one water district and one municipality, respectively, in active competition to secure this source of supply. There would doubtless have also been one or more syndicates of shrewd business men who, appreciating the situation, would have endeavored to secure the reservoir site with the expectation of turning it over with a good profit to some one of these five interests."

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"The importance of the Calaveras source of supply can be appreciated by remembering that its safe yield is at least equal to, and doubtless in excess of, the total amount of water then consumed in the city of San Francisco; considerably in excess of the total supply which is controlled by the Peoples Water Company, both developed and possible of development; and considerably over twice as much as the quantity supplied to its consumers by the Peoples Water Company.

"There is nothing else near by comparable in availability. On the east side of the bay, the undeveloped sources of the Peoples Water Company are far inferior, for several reasons. They cannot be made to yield half as much water; the cost will be materially greater per unit of capacity; the elevation of the points of delivery are lower; and the watersheds cannot be enough protected to obviate the necessity for filtration. On the San Fran-

cisco side, the developed resources were being utilized to their safe limit.

"The Calaveras watershed is so sparsely inhabited, and the amount and time of storage so considerable, that the Calaveras waters will be more satisfactory without the filtration than either the developed or undeveloped supplies of the Peoples Water Company with filtration. In addition to this advantage of the Calaveras project, there are several others; the elevation of the intake, where the water surface will average about 700 feet; the earthen dam; and so far as the east side is concerned, the short length of pipe line. It is only 36 miles, by the pipe line route, to the Central Reservoir in Oakland, and over two-thirds of it follows closely the line of two railways. The estimated cost of the works, delivering 40,000,000 gallons daily to Oakland with a one-third excess pipe capacity, is only $10,000,000, or but $250,000 per million gallons daily, and to San Francisco about $16,000,000, or $400,000 per million gallons daily."

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"It was, furthermore, a matter of common knowledge that the development of this reservoir site was not only inevitable, but imminent, and that there would have been no doubt of the existence of an immediate demand for the land for reservoir purposes, either on the part of the owner, or of anyone contemplating their purchase.

"Taking all these elements into consideration, it is my judgment that the holder of this reservoir site could, December 31, 1913, have sold it for at least $600,000, and might well have obtained a very much higher figure. I do not think any prudent owner would have opened negotiations for anything less than one million dollars, because even at the latter figure, the cost of the reservoir lands—absolutely vital to the project—is so small a percentage of the total cost, I do not think any prudent executive of any one of the several interests mentioned would have risked much parleying.

"Accordingly, I believe it is conservative to say that the market value of the Calaveras Reservoir site at the time in question was at least $600,000, and probably considerably more. Since it is proposed to flood 1928 acres, this is equivalent to $311.20 per acre. This is very much less than the figure at which it was possible to acquire any one of the undeveloped reservoir possibilities of the Peoples Water Company, which are the only ones, other than the San Antonio or Arroyo Valle, existing in the east bay region."

THE MASTER: Mr. Cory made his figure only for the reservoir area?

MR. OLNEY: Yes.

MR. SEARLS: May I ask you, Mr. Greene, whether Mr. Cory's figure and Mr. Grunsky's figure were included in the final tabulations, either of Mr. Hazen or of Mr. Metcalf?

MR. SHARON: Mr. Metcalf took Mr. Grunsky's valuation of the reservoir.

THE MASTER: I thought, Mr. Greene, that you said something on the opening day of your argument to indicate to my mind that you were not claiming a reservoir value for Calaveras in the rating base.

MR. GREENE: I didn't mean to, your Honor, if I did. What your Honor probably has in mind is that Calaveras was not actually in use as a reservoir in 1913.

MR. OLNEY: (continuing reading)

"**The San Antonio Reservoir:**

"The San Antonio Reservoir would make possible a safe yield of only about one-sixth that from the Calaveras unit, which is so small, relative to the gross requirements of the region, that it may be many years before the site is utilized. It may well be that it will never be utilized. It's value for reservoir purposes is, therefore, somewhat speculative and remote. Under these circumstances, its market value will be largely controlled by the

value of the land for agricultural purposes, and will not greatly exceed that value.

"It is certain, however, that in view of the fact that it is known to be a good reservoir site and generally recognized as such, and is included as a part of the Freeman Hetch Hetchy project, its market value as a unit was substantially in excess of its value for agricultural purposes. No owner of the land as a unit would sell the property for a price which did not take into consideration its availability for reservoir purposes, and, on the other hand, any person contemplating its purchase would be willing to pay more by reason of this fact.

"I understand that the lands have been valued at between $50,000 and $60,000 for agricultural purposes."

Of course, Mr. Cory's understanding on that point was erroneous, the lands were valued at about $35,000 by both Gale and Schween, and at quite a little less than that by Parsons and Callaghan.

THE MASTER: And this, too, is the reservoir lands, only?

MR. OLNEY: And this, too, is the reservoir lands only.

"Under all the circumstances, I am convinced that a figure exceeding its agricultural value by at least one-third, or, on the basis of the property being worth for agricultural purposes $60,000, a figure of $80,000 is conservative, and that it had on the 31st of December, 1913, a market value of at least that sum.

"**Arroyo Valle:**

"This is more of a regulating than a storage reservoir, and is even less essential to the urban communities than San Antonio. On the other hand, its construction would be an excellent thing for the entire Pleasanton Valley. All things considered, there would be just about the same excess of market value over agricultural value here as at San Antonio, namely, one-third. Since the agricultural value is about $35,000, a figure of $50,000 is conservative, and it is my judgment that on December 31, 1913, its market value was at least that sum."

Here, again, Mr. Cory was misinformed as to the agricultural value. My impression is that the agricultural value of the Arroyo Valle lands, as fixed by Schween and Gale, was about $15,000.

MR. McCUTCHEN: It should have been a little more than that on the figures of Mr. Grunsky; you said that Mr. Grunsky's valuation adds about $4000.

MR. OLNEY: Yes.

MR. SEARLS: Schween's valuation was $14,885; that is nearly $15,000.

MR. OLNEY: And Callaghan's figure was lower than that.

It is of course difficult to check in any definite manner these figures of Mr. Cory. We can ascertain if he has approached the problem from the correct point of view and has taken into consideration the various factors which affected it. I think his testimony makes it clear that he has done this. With regard to his final figures, about all that can be done is to see if they commend themselves to our judgment. When we consider the actual situation as it existed in 1913, I confess that it seems to me that Mr. Cory's figure of $600,000 for the Calaveras reservoir site as a whole is probably more nearly correct than Mr. Grunsky's figure of a little less than $400,000.

The circumstances were that the existing water supply sources of both San Francisco and the east bay communities had been developed to their full extent and a further supply from some additional source was imperatively demanded. Of all the sources available for additional supply Calaveras was by far the most valuable. There was no other that could be compared with it. It would furnish more water and at less cost than any other possible source. This was true, even though it should cost much more than $600,000 to acquire the reservoir site. If we assume, as we are entitled to assume, for the purpose of valuing it, that on December 31, 1913, it was free of any public use and open to sale, and held in one ownership by an individual, who was willing to sell it but was not compelled to sell it at a sacrifice, it does

seem to me that $600,000 would have been an exceedingly low figure to have been realized for it. Spring Valley Water Company would certainly have been in the market for it; the Peoples Water Company would, likewise, have been in the market for it if in any way it could have obtained the means to purchase; and it is altogether probable that there would have been other individuals, or associations of individuals, who would have desired to buy it, either for the purposes of utilizing it themselves or for the purposes of holding it as a speculation. The necessity for its use was too imperative and too well and generally recognized, to cause any one to hesitate at paying $600,000 for it when, at this price, it was still the best and cheapest water supply as yet undeveloped anywhere about the bay of San Francisco. Not only this, but it would be developed cheaper than the existing water supply of either San Francisco or the east bay cities.

I come now to Mr. Dillman's testimony.

If Mr. Dillman is to be considered as testifying to market value, I have already called attention to the fact that his figures for the Peninsula reservoir sites are so low as to be manifestly incorrect. They are $1260 for the Pilarcitos Reservoir site; $88,400 for the San Andreas Reservoir site; and $471,680 for the Crystal Springs Reservoir site. The same thing is true as to his figures for Calaveras. His figure is $80.50 an acre for the Calaveras Reservoir lands, or $155,305.

Assuming that on December 31, 1913, all of the Calaveras Reservoir lands had been gathered into one ownership, as they had been, and assuming that they were free of any public use and available for sale in the open market, and that the owner was ready to sell but not in a position where he was compelled to sell, I think it admits of no argument that he could have obtained in the open market a figure far in excess of $155,000 for the property.

I do not think that Mr. Dillman himself would wish to be considered as having testified that this was all that could have

been obtained for the land under such circumstances. In fact this figure is not as high as the figures of some of the witnesses who testified to the value of the Calaveras lands omitting any consideration of their value for reservoir or water supply purposes.

The total of Mr. Gale's figures for the Calaveras Reservoir lands is $188,525; of Mr. Park's, $290,516; of Mr. Clayton's $280,-700; and of Mr. Parson's something over $134,000; and of Mr. Callaghan's something over $137,000.

I say that Mr. Parson's figure for Calaveras Reservoir lands is something over $134,000, and that Mr. Callaghan's is something over $137,000, for the reason that neither of these witnesses in his valuation segregated the reservoir from the watershed lands. Most, if not all, of the tracts valued by them contained large amounts of watershed lands. The figures of $134,000 and $137,000 were obtained simply by taking the average per acre value for each tract valued by them and applying this average to the reservoir lands included in the tract.

THE MASTER: You mean you have taken their average for the whole Calaveras holdings and applied it to the reservoir area?

MR. OLNEY: Yes, with this limitation, that of course we have taken into consideration only those tracts which included reservoir lands; that is to say, it did not include the whole Calaveras watershed. Most of the tracts which included reservoir lands also included large quantities of watershed lands and we simply took the average.

Manifestly this average is too low, inasmuch as the watershed lands are hill lands and admittedly much less in average value than the reservoir lands simply because the latter are valley lands and more valuable for farming purposes.

I have made no particular examination into the matter, but it is very probable that if these two witnesses had segregated their values as between reservoir lands and watershed lands their valuation on reservoir lands alone would have exceeded by more

than $20,000 the $134,000 and $137,000 arrived at by the method indicated. In other words, Mr. Dillman's figure for the Calaveras of $155,000 is, in all probability, no greater than the valuation of the city's own witnesses on the same lands, admittedly made upon the basis of considering only their value for agricultural and grazing purposes, and it is very much lower than the similar valuations of the plaintiff's witnesses.

MR. SEARLS: In justice to Mr. Dillman, Mr. Olney, he used a percentage to add to the agricultural valuation, of which he knew nothing, and therefore if the reservoir acreage should be increased that way you would have to increase Mr. Dillman's figures proportionately.

MR. OLNEY: I am coming to that.

The truth is, as I have said, that Mr. Dillman was not testifying to the market value at all. It is not easy, in fact it is impossible, to make out with exactness just what he was testifying to, but he very evidently thought he was testifying in regard to cost. He begins his paper (6496):

"This is an estimate of probable cost. I have been rather careless in using the term 'value' because value is a matter purely of opinion. There are some matters of fact connected with cost, but small connection often times exists between cost and value."

This same idea appears again and again on cross-examination. For instance, beginning on page 6575 he testifies:

"Q. That is to say, as between Mt. Diablo and Crystal Springs, you still insist that Crystal Springs was not worth any more than its value for agricultural purposes, do you?

"A. Crystal Springs, to the water system, is worth a large and indefinite amount of money, but this estimate, as I started to say yesterday, is an estimate of probable cost, and I am considering the acquisiton of Crystal Springs, not as an inhabited country covered with costly homes, but as open land, or as it exists now practically, without the construction of the dam.

"Q. You say that Crystal Springs, as part of this system, is worth a great deal of money? A. Yes, sir.

"Q. Do you mean by that it is worth a great deal more money than the figure you put upon it? A. It means that I would not separate it from the system for a great deal more money than I have put upon it, yes.

"Q. Does it mean that it is worth, in your opinion, a great deal more money than you have put upon it?

"A. Worth and value is still a matter of opinion, and I am approaching this from a cost analysis only.

"Q. You know what value means, do you not? A. There is nothing definite about value, there is nothing fixed about value.

* * * * * * * *

"MR. McCUTCHEN: Q. Let me ask this: What distinction do you draw between cost and value here, in your testimony?

"A. There is very little connection between cost and value, except at the time of acquisition, and sometimes very little then."

Again, on page 6518, the following took place:

"Q. Are you prepared to state what was the market value of the land covered by water in Crystal Springs reservoir on the 31st day of December, 1913? A. No, sir."

Coming now to the detail of Mr. Dillman's testimony. There are six matters or points in connection with it which I desire to consider. These are:

First and second: His two alternative methods of valuing the property, if, following his precedent, I may use the word "value" carelessly;

Third: His criticism of a valuation of $1000 an acre on the Crystal Springs property;

Fourth: His omission of any element of value due to the lands being peculiarly suitable and available for reservoir purposes;

Fifth: His reasons for saying that the San Antonio and

Arroyo Valle sites have no value for reservoir purposes at all; and

Sixth: That his testimony is clearly incompetent.

The first method pursued by Mr. Dillman is stated on pages 6497 and 6498 of the transcript. What he did was to take the original costs of the Peninsula reservoir lands, as those costs had been figured out by Mr. Bailhache, and then add to these figures, without compounding, five per cent for each year that the company had held the property, up to 1913. He figured that the company had held the Crystal Springs property for thirty-six years, and thirty-six times five per cent is 180%. He accordingly figured that the value of the Crystal Springs lands was, in 1913, 180% greater, that is, 280% of their cost when acquired.

Mr. Dillman did not pretend to testify as to the figures of original cost. Those were Mr. Bailhache's. He himself says, on page 6523 of the transcript: "This is not my schedule. Mr. Bailhache had put this in here. He made the figures at my request, if you please. All that I have used are his conclusions. I don't know whether these figures are right. They are not so outrageous that they seem unreasonable, and therefore I have taken them."

Now, if Mr. Dillman's method consisted, as it actually did, in taking somebody's else figures as to cost and then adding five per cent, without compounding, for each year after the company acquired the property, it is perfectly evident that the only thing that Mr. Dillman has testified to is that in valuing the property for the purpose of this litigation it is proper to take the original cost to the company of reservoir properties and add five per cent per annum, without compounding. This, and nothing but this, is the sum and substance of Mr. Dillman's testimony so far as his first method of figuring is concerned.

If it is nothing else it is at least naive. It certainly does not conform to any of the recognized theories of making a valuation. It is not original cost. It is not reproduction cost, and it is certainly not present value.

It hardly seems necessary to consider the reasons which Mr. Dillman gives. Possibly, however, they may be of some assistance in weighing his testimony.

In his written paper, which, presumably, he prepared with care, he states his reasons as follows: (6498):

"If the lands had not been purchased then [i.e. at the time of original acquisition] but had been recently acquired, the original cost (value) should have increased about as other agricultural lands, say 5% per annum. The reason for using 5% is based on my opinion that real estate investments properly made should yield about 5% to the investor, and while in some cases they do not—and in other cases they yield a great deal more—if a man is assured of 5% on that kind of investment with that kind of security, it will receive a great consideration by the investing public. It seems to me, moreover, that if the owner is allowed 5% a year appreciation in the value of reservoir lands in the long run the increase in value of his investment will approximate the increase in value for other classes of real estate investments and that full justice will be done."

It would seem as if at least two very different ideas were here confused. One is that agricultural lands increase in value at the rate of about 5% per annum, without compounding, and the other is that real estate investments, properly made, should yield about 5% to the investor, with the implication that it is, therefore, fair to allow that percentage to the public utility company. Subsequently, however, Mr. Dillman apparently confines his reason to the fact that in his judgment the increment in value of farm lands is about 5% per annum without compounding. This, I take it, is the final result of his cross-examination, although it is not certain. Thus, beginning on page 6524, he testifies:

"Q. Do you regard it as scientific to compute simple interest on investment in land? Is that the way the land owner does?

"A. I think when the annual returns on the rates are considered, that 5% is very liberal.

"Q. Well, do you recognize that at the end of the first year the man has his principal and 5% also to make use of?

"A. His 5% is only an increment in the value that I have allowed.

"Q. And you think it scientific to simply allow him simple interest and not give him the benefit of compounding his increment from year to year? A. Well, you could figure it at compound interest, if you wanted to, but it would be a lower rate.

"Q. Why a lower rate? You have said that land increases 5% per annum? A. But not at a compound rate.

"Q. If you buy a piece of land in January, 1867, would you suppose it would be worth 5% more on January 1, 1868?

"A. I should hope so, I should hope it would be.

"Q. And you would start with a new principal on January 1, 1869, wouldn't you, too? A. If you figured with compound interest you would.

"Q. I am not asking you if you figured, I am asking you about the scientific way of attacking it: What is the fact?

"A. This method is just as scientific as to use any compound interest tables.

"Q. How is it just as scientific if you say the property increased in value at the rate of 5% per year?

"A. Because it is near the probable truth.

"Q. 5% on what? A. 5% on its original cost.

"Q. 5% on its value from year to year? A. No.

"Q. You say that would not be correct? A. No, it would be too much.

"Q. It would be? A. Yes.

"Q. In other words, the man, in your opinion, who invested in land in 1867 or 1868 could not hope to make as much return as if he had deposited his money in a savings bank? Would he get interest on interest in that case?

"A. Yes, but he is getting more than this 5%, he is getting returns on rates right along in addition to the 5%. The 5% is an increment over and above what he gets in rates.

"Q. What do you mean by rates? A. Water rates.

"THE MASTER: Q. Suppose you take out the idea that it is public service land, Mr. Dillman, and assume that it is grain land. The point you are referring to is that this 5% which you compute on a simple interest curve is the increase in value going along with an assumed return from the property that is otherwise used. A. Yes, sir.

"THE MASTER: Obviously, Mr. McCutchen, if 5% was all that was received, Mr. Dillman would not be allowing enough, you would have to compound it. He is assuming, as I take it, that the land owner is getting something all the time, and he is just trying to figure the increase in the value of the principal.

"MR. McCUTCHEN: I so understand Mr. Dillman, and I am asking him whether that is a scientific way of getting at it.

"A. Absolutely.

"Q. You base that, do you not, upon the statement that land such as this did actually increase at the rate of 5% per year in value—is not that what you base it on? A. I have a good deal of knowledge about the increment of land prices; if land will increase in value on the average of 5% per annum, computed at simple interest, it will be better returns than the average of farm lands that I am acquainted with, and I am acquainted with a great many farm lands.

"Q. Mr. Dillman, do I understand you correctly when I do understand you to have said that in your opinion these lands increased in value at the rate of 5% per annum.

"MR. SEARLS: It is perfectly plain that he means an average rate of 5%.

"MR. McCUTCHEN: I am asking him what he means. I am perfectly willing he should take whatever position he pleases.

"A. In this estimate I have considered that these lands did increase 5%.

"Q. Each year? A. On an average. Land goes up by jumps and sometimes goes down, but the curve is generally up, and if you get an average of 5% increase per annum you are doing pretty well, in farm lands or other lands."

Now, it might be possible to justify a statement that an allowance to a company of 5% per year simple interest on the original cost of its land was fair as between the company and the public, for what is fair is a rather indefinite thing, but it is wholly impossible to justify the statement that the average rate of increase of lands is 5%, or any other per cent per annum, simple interest. An increment in value is essentially something added to the principal. In other words, it is essentially a compounding. Furthermore, this compounding cannot be commuted into simple interest,—and this is something that Mr. Dillman ought to have known, as an engineer, or an expert in such matters—for if we attempt to do so the rate of interest will vary according to the length of time the property is held, although the rate of increase year by year may be exactly the same. For example, if land is increasing at the rate of 5% per annum, at the end of twenty years it will have increased 165% or 8¼% per annum at simple interest; and at the same rate of increase for forty years it will have increased 603%, or at the rate of over 15% per annum simple interest.

Reversing the process, if increment in value is to be figured according to simple interest, the longer a man holds a particular piece of property the less will be the rate of increment on its real value. Thus, assume a man purchases a piece of property for $100, adding a 5% increment, at the end of the year it is worth $105. If he holds it for a second year, the increment, according to Mr. Dillman's theory, would be still $5, which is less than 5% on the value of $105, with which he began the year. At the beginning of the third year its value, according to Mr.

Dillman, will be $110, but the increment in value during the third year would still be only $5, or still less than the increment for the second year, and so on ad infinitum.

We can apply Mr. Dillman's theory to this particular case and reduce it to an absurdity. For instance, assume that these properties were bought forty years ago and cost $100,000—then, according to Mr. Dillman's method of computation, they should be increased in value now by forty times 5%, or 200%, making an increase of $200,000, or a total value of $300,000. But now suppose the same properties were bought only twenty years ago—by this time, that is, only twenty years ago, the property would, according to Mr. Dillman's theory, have increased in value twenty times 5% of their worth twenty years before and would be worth $200,000, and this amount the company would have to pay for the lands, according to Mr. Dillman's theory and would be justified in paying. In this case we would then start with a purchase only twenty years ago of $200,000 and to bring the valuation down to date, according to Mr. Dillman we should add twenty times 5% of this figure, or $200,000 more, making a total of $400,000. In other words, according to Mr. Dillman's theory, assuming that in the one case the lands were purchased forty years ago and in the other case twenty years ago, and that there was no difference in respect to the purchases, and that the rate of increase during the whole period of forty years was the same, their value at the present time for rate-fixing purposes would be in case the lands had been purchased 40 years ago $400,000, and in case they had been purchased 20 years ago $300,000.

MR. SEARLS: Your premise begs the question, because you assume the price would have been the same 40 years ago or twenty years ago.

MR. OLNEY: That is just exactly what I do not. You start 40 years ago with a price of $100,000, which the company pays. You add 40 times 5 and you get 200%; so that the property has increased in the 40 years 200%, or $200,000, which you add

to your original cost, $100,000, giving you as the total present value $300,000. Now, we will make the same assumption that those lands were worth 40 years before $100,000, but we will also assume that the company did not buy them then, but bought them 20 years later. When it bought them it would have to pay their value at that time. According to Mr. Dillman's method, their increase in value during the 20 years preceding the company's purchase would be 20 times 5, or 100%, which, added to the original cost, makes 200%, so that the company purchasing only 20 years ago instead of 40 would, according to Mr. Dillman's theory, pay $200,000 for the land. Now, if, 20 years ago, the company paid $200,000 for the land, adding 5% each year simple interest as the rate of increase for the 20 years since the purchase, brings you out with a total present value of $400,000 as compared with $300,000 in case the company had purchased the lands 40 years ago. As I say, the thing reduces itself to an absolute absurdity.

MR. SEARLS: I think your point is good on that.

Mr. Dillman's second or alternative method of figuring is stated in his paper as follows: (6499 to 6500)

"An alternate method of valuing Peninsula reservoirs suggests itself if the real estate value of the flooded lands in 1913 should be assumed. When a corporation has acquired the lands of a reservoir site, and built their storage, the matter of entire feasibility is settled. The business is behind one. All doubts are removed. This increases the value to the corporation, which is reflected in the added stability, or increased market price of their securities.

"But these increased costs and added values are not enormous in amount. They are not at all uniform. I estimate it at about 25% in the case of Peninsula reservoir lands, and 15% in the Calaveras.

"The difficulty in applying this 25% on lands on the Peninsula lies chiefly in the difficulty of ascertaining the real estate

value of the lands in the flooded area in 1913. After a casual examination of the figures introduced in this case as showing value of adjoining lands, I have assumed—and it is a pure assumption—that a fair basis for figuring these reservoirs would be about as follows:

Crystal Springs .....$250 per acre
San Andreas ..... 175 per acre
Pilarcitos ..... 50 per acre
Calaveras ..... 70 per acre''

THE MASTER: For the watershed?

MR. OLNEY: No, these are the reservoir lands.

MR. SEARLS: But it is based on the watershed appraisal of these witnesses, I think you will find?

MR. OLNEY: No, it is not based on the watershed appraisals at all, Mr. Searls; I have not the reference here, but I am thoroughly familiar with Mr. Dillman's testimony and I know that that is not the fact. He says in his testimony that he has gotten at this figure, for instance, for Crystal Springs, of $250 an acre by taking the average as best he could get at it by a casual examination of the values placed on the immediate adjoining lands.

MR. SEARLS: Yes, that is my understanding.

MR. OLNEY: Very well, then we are agreed. He has assumed though that the value would be some guide as a basis for valuing the lands beneath the water.

THE MASTER: Yes, and these figures are of water lands.

MR. OLNEY: These are of water lands.

THE MASTER: What was his figure for Calaveras?

MR. OLNEY: $70.

THE MASTER: Obviously that must be in addition to the watershed because the city's witnesses did not fix such a figure as that, as I understand it.

MR. OLNEY: No.

"Applying these percentages as indicated, the total value per acre of these reservoir sites would be about as follows:

Crystal Springs	$312.50
San Andreas	218.75
Pilarcitos	62.50
Calaveras	80.50

"For other suggested reservoirs, such as Arroyo Valle and San Antonio, I add no percentage, because I do not consider their adaptability for reservoir use is established.

"It is, of course, understood that these assumptions of basic realty values on my part are purely on the basis of what seemed reasonable to one who is not qualified as a realty expert, and so far as they may be changed by the court, by so much my reservoir value per acre would be increased or diminished."

The essence of this method is, of course, simply to take present real estate value, as Mr. Dillman calls it, of the reservoir lands —that is, their value as agricultural, grazing or suburban properties, omitting any element of value due to their peculiar suitability for water supply purposes, and then to add 25%, in the case of Peninsula reservoir lands, and 15% in the case of Calaveras. Mr. Dillman does not pretend to testify to what this so-called real estate value is. As he says, (6499): "After a casual examination of the figures introduced in this case as showing value of adjoining lands, I have assumed—and it is a pure assumption—that a fair basis for figuring these reservoirs would be about as follows:" and again he says (6500): "It is, of course, understood that these assumptions of basic realty values on my part are purely on the basis of what seemed reasonable to one who is not qualified as a realty expert, and so far as they may be changed by the court, by so much my reservoir value per acre would be increased or diminished."

On pages 6528 and 6529 he says, on cross-examination, that the basic figures which he has taken are Mr. Smith's figures and

if these figures are wrong, to that extent his own figures are wrong.

In other words, the sum and substance of Mr. Dillman's testimony, as far as this alternative method is concerned, is that it is fair to take the value of the reservoir properties, omitting any consideration of any element of value which they may have due to their peculiar suitability for reservoir purposes, and then add 25% in the case of the Peninsula reservoirs and 15% in the case of Calaveras.

Now if this 25% or 15% represents in Mr. Dillman's opinion the amount to which the market value of the property for general purposes was increased by its peculiar suitability for reservoir purposes, we might differ with the results he reaches, but we could not differ with his method. But this is just exactly what Mr. Dillman's percentage does not represent. It is difficult to make out just what it does represent, but it is certain that it does not represent this. Thus Mr. Dillman says (6500 and 6501):

"The right to condemn for reservoir or other public service uses limits the cost to what would be allowed by a jury in condemnation. The owner is given the maximum value for all purposes. All the purposes that he can use these lands for are other than reservoir purposes, so in the case of the Spring Valley reservoirs the maximum cost that would be allowed, or it would be proper to pay without condemnation, is the maximum value of the lands for grazing, agricultural, residential, and other uses, but does not include any consideration for reservoir purposes."

The same idea, that no increase in value should be allowed because of the peculiar suitability of these properties for a public use, occurs again and again in Mr. Dillman's testimony. What did the 25% or the 15% represent in Mr. Dillman's mind? It is difficult to ascertain. The only statement in his paper I have already read. It is (6499):

"But these increased costs and added values are not enormous in amount. They are not at all uniform. I estimated at

about 25% in the case of Peninsula reservoir lands and 15% in the Calaveras."

According to this there are two factors "these increased costs" and "added values." But what increased costs? Increased costs are not mentioned in the paper, either before or after this statement. Mr. Dillman, however, some paragraphs before, and in connection with his first method of figuring, has been speaking of the fact that purchases by a public utility company of lands which it desires are not generally made at the lowest market prices and that the owner boosts his price. This is probably the "increased cost" referred to. If it is, of course Mr. Dillman is following the very method that was condemned in the Minnesota Rate Cases. He is taking the value of the land and applying to it a multiple in order to get the probable cost of re-acquisition. More than this, assuming that this is what Mr. Dillman had in mind, what he has done is, in this particular case, peculiarly unjust to the company, for the reason that he has taken as basic values the values simply of adjoining lands, when, as a matter of fact, the market value of those lands is necessarily lower than that of the reservoir lands, both because they are hillside lands, while the reservoir lands are generally valley lands, and because, also, the reservoir lands, by reason of their suitability for reservoir purposes, have a higher market value regardless of any need of the water company for them or of the fact that the water company is seeking to acquire them.

As to the other factor making up the 25% or 15% which Mr. Dillman mentions, the factor of "added values", Mr. Dillman's paper does state what he means. He says, immediately preceding on page 6499: "When a corporation has acquired the lands of a reservoir site and built their storage, the matter of entire feasibility is settled. The business is behind one. All doubts are removed. This increases the value to the corporation, which is reflected in the added stability or increased market price of their securities. But these increased costs and added values" etc.

In other words, the "added values" referred to by Mr. Dillman are "the added stability or increased market price of their [the water company's] securities." Now what in the world the added stability or increased market price of the water company's securities have to do with increasing the value of its reservoir lands, I am wholly unable to see and I think does not require discussion.

Mr. Dillman's various explanations of this 25% on cross-examination were not quite as numerous as the questions asked him about it, but they were numerous enough and various enough to make it impossible to ascertain exactly what he did have in mind, if he had anything exact at all.

Thus, on page 6520, he says:

"If the dam had not been constructed in 1913, those lands would have had a market value and they would have been acquired at some price. I don't know any more definitely about what that price would probably be than I have given, $312.50 it figures up, but that is no definite figure. It may be high and it may be low. But after it was developed and the reservoir was made, then those lands were available for absolutely nothing but reservoir purposes and I have put that value, with the reservoir constructed, at say about 25% above what it cost. That is because of the proven feasibility and practicability of the thing."

Again on page 6543, the transcript reads:

"Q. Why do you add 25% to the values which you arrive at for the purpose of getting the reservoir value? A. Well, I thought something should be allowed. The land is absolutely taken away from any other possible use and dedicated forever to reservoir use. The feasibility of storage is entirely settled; the dam is built; the safety of the reservoir is assured. I thought it should have some addition. I am not very hidebound about the 25%. I think it is enough. I think it is ample to cover all these things, because, after all, this is an estimate of probable

cost and the acquirement of those same lands might be a little bit higher in value for other purposes if it were done over again and no wrong was done the company by adding the 25% and I don't think much wrong has been done the community by adding the 25%. I think it is a very fair proposition.

"Q. Well, you cannot give us any more reasons for your taking the 25%? A. No.

"Q. You might with equal propriety have taken 100%?

"A. If I thought the lands had"—this word, I think, should be "would"—"would cost approximately twice as much to re-acquire them I would have added 100%."

In other words, it is there the cost of re-acquisition. Again along the line of this 25% representing not the demonstrated feasibility or practicability of the reservoir site, but as the cost of re-acquisition, he says, on page 6544:

"I have not attempted to appraise these lands with an independent appraiser. I have not done that.

"Q. No, but you have stated what they could be acquired for if they were not used for this purpose? A. I have concluded they could be acquired for 25% more than the appraised value of them, yes.

"Q. What experience have you had that enables you to determine that they could be acquired for 25% more than what you took to be the appraised value of the adjoining lands?

"A. I have been connected with the acquirement of a great many rights of way, and railroads, and so forth."

And again, at page 6545, he says:

"Q. And you allowed that 25% because in your experience 25% has been enough to allow in the acquisition of rights of way and terminals for railroads, is that correct?

"A. Yes, I believe it is.

"Q. And that is the only reason? A. Yes, that is a sufficient reason. Let it go as the only reason."

A little later, at page 6548, he gives an entirely different reason, as follows:

"Q. Now, let us see if we can get on common ground. Up to the time the dam was built this property did not have any value because of its availability for reservoir purposes?

"A. Yes.

"Q. That is correct, is it?

"A. Up to the time of its acquirement.

"Q. Well, up to the time of its acquirement? A. Yes.

"Q. We will assume that it was owned by the San Mateo Water Works, but had not been used for reservoir purposes and that the Spring Valley Water Company wanted it.

"A. Well if it was in one holding, a part of the 25% had accrued.

"Q. A part of the 25% had accrued? A. Yes.

"Q. How much of it? A. I don't know, I am not going to split it up.

"Q. Was it the assembling of it under one ownership that made it worth more.? A. Yes, I think so.

"Q. It was not its availability then that made it worth more?

"A. The availability preceded the assembling of it.

"Q. We will use the word "usefulness" instead of "availability." It was just as useful for reservoir purposes when it was in a dozen ownerships as when it was assembled under one ownership, wasn't it? A. No, sir. Q. It was not?

"A. No, sir.

"Q. It became useful, then, only when it was acquired under one ownership for reservoir purposes? A. It became possible then.

"Q. And not before that? A. No.

"Q. Then, when it was acquired under one ownership it took on this additional value to the extent of part of the 25%?

"A. Yes.

"Q. And it took on the remainder of the 25% in value when

the dam was built? A. Yes.

Then, again, on page 6589, Mr. Dillman said:

"Q. Just what did you mean by this statement, Mr. Dillman, and I read now from page 3: 'An alternative method of valuing Peninsula reservoirs suggests itself if the real estate value of the flooded lands in 1913 should be assumed. When a corporation has acquired the lands of a reservoir site and built their storage, the matter of entire feasibility is settled. The business is behind one. All doubts are removed. This increases the value to the corporation, which is reflected in the added stability, or increased market price of their securities.'

"A. I mean just what I said.

"Q. That is to say, you meant that as long as the property was acquired and assembled in one ownership and converted into a reservoir the land became very much more valuable than when it was in several ownerships? A. Well, I have considered that this accretion of 25% was part of it on the assemblage of the land, and part of it on the construction of the works, and the demonstration of the feasibility of storage"

I do not desire to discuss Mr Dillman's 25% accretion any further. It is perfectly evident that it does not represent Mr. Dillman's opinion as to the amount which should be added to the market value of the lands considered simply as agricultural, grazing, or suburban lands in order to get their true market value, taking into consideration the peculiar factor of value which they undoubtedly have, namely, their suitability and availability for reservoir purposes. I think it is clear that it is impossible to make out, with certainty, what Mr. Dillman really did have in mind. The most probable guess is, in view of his reiterated statement that his estimate is one of cost and not of value, that he added the 25% partly because of a general idea that it was fair and partly as covering the probable cost of reassembling and reacquiring the lands, assuming that they were held in divided ownerships in the various parcels in which they were originally

acquired, and that this 25% represented in part the expense, or rather, the increased amounts which would have to be paid the different owners over what would have to be paid a single owner, and in part the additional amount which such owners would insist on because of demonstrated feasibility of the lands for reservoir purposes. The point of the matter is that his method is not a competent method of valuation in any case.

I come now to my third point in connection with Mr. Dillman's testimony, namely, his criticism of a valuation of $1000 an acre on the Crystal Springs property.

In his written paper, on page 6501, he figures out that if the Crystal Springs reservoir lands were worth $1000 an acre, the Crystal Springs reservoir completed would cost $44.60 per acre foot of capacity, and then he says: "This is such expensive storage that economical consideration would, in my opinion, warrant the abandonment of the project. It is always possible to pay too much for a desirable thing." On cross-examination he testified repeatedly that in his judgment the Calaveras reservoir was a good site and worth developing and also that he supposed that the cost of storage at Calaveras would be from $30 to $40 an acre foot (6515).

Now, if the Calaveras is worth developing at a cost of $40 an acre foot, certainly the Crystal Springs, so much closer in to the city, would be worth developing at a cost of $44.60 per acre foot.

Then again, on page 6570, he testifies as follows:

"Q. Then you would say that anything over $40 was a prohibitive figure, wouldn't you? A. No, sir.

"Q. What figure would be prohibitive? A. $100.

"Q. $100? A. Yes.

"Q. Would $50 be prohibitive? A. In some cases.

"Q. In what cases would it be prohibitive? A. It would be prohibitive for storage for irrigation purposes.

"Q. Would it be for domestic purposes? A. Not always.

"Q. In what case would it and in what case would it not?

"A. Well, if storage was necessary and $50 or $100 was the cheapest that could be gotten, that would be the storage to make. * * *

"Q. Would $50 be prohibitive on the Peninsula? A. No, sir.

"Q. What did you mean, then, by saying in your paper: '68,800 feet capacity at $44.60; this is such expensive storage that economical consideration would, in my opinion, warrant the abandonment of the project.' I read that from page 6 of your statement. What did you mean by that?

"A. Well, that seems to be a contradiction. I presume my opinion at that time was that it would be pretty high; at the same time these matters are relative, and there are cases where storage costs considerably more than $50 and yet it is advisable to make it. * * *

"Q. Was that a well considered opinion, Mr. Dillman, when you penned it here? A. It is probably about the limit of what would be practicable as the cost of storage for San Francisco.

"Q. My question is, was this a well considered opinion when you expressed it, was it expressed after careful and thorough consideration?"

(It is to be noted that this statement was a part of Mr. Dillman's written paper.)

"A. I rather think I would revise it to the extent of saying it was hardly prohibitive, but it would be very high.

"Q. For domestic purposes? A. Yes, sir.

"Q. Do you know anything about the cost of storage per unit in reservoirs in the East. A. The necessities of the case there would warrant——

"Q. Answer my question, please? A. I have read reports; I know nothing about them in detail.

"Q. Have you ever read that the cost per unit, that is to say, the unit which you employ here, very frequently reached over $300? A. No, sir, I have never read it. The necessities of the case there are much greater than they are here. New York and

Boston have to pay a great deal for their water.

"Q. Mr. Dillman, you are here testifying as an expert on water works construction and water works valuation, are you not?

"A. To the extent that I am an expert, yes.

"Q. Do you testify that it is your opinion that the necessities for storage in the East are greater than they are in California?

"A. The——

"Q. Answer the question 'Yes' or 'No' and then make your explanation.

"MR. SEARLS: I think there could be lots more harmony in this proceeding, if you would not be so insistent about 'Yes' or 'No' all the time; it is very irritating to me, and I suppose it is to the witness.

"MR. McCUTCHEN: I am sorry to irritate you, Mr. Searls; it is my habit; I can't help it.

"A. The necessities are different; the necessities in the East are for quantity, the necessities here are for time.

"Q. Quantity and time; what distinction do you draw between them? A. The distinction is that the storage in the East is used up in greater quantity in a short time, and here it is used up in less quantity, but in longer time.

"Q. Is storage more important here, or in the East?

"A. It is absolutely necessary in both cases.

"Q. Is it necessary to the same extent in the East as it is here? A. Not as far as time goes; as far as quantity goes, yes.

"Q. Is as much storage required to develop a given quantity of water in a given period in the East as is required here?

"A. No, sir.

"Q. And yet you say the necessities of the case are greater in the East than they are here, as applied to reservoirs?

"A. They apparently are, from the fact that storage has been pretty expensive in the East; they would not have been if there had been cheaper storage there."

I think no comment on this answer or on Mr. Dillman's con-

demnation of the Crystal Springs reservoir as too "expensive" if its lands were to be valued at $1000 an acre, with the consequent cost of $44.60 per acre foot of storage, is necessary.

The fourth point in connection with Mr. Dillman's testimony is that, overruling not merely the Supreme Court of the State of California, but the United States Supreme Court as well, he refuses to include as an element of value any value which the property may have for reservoir or public utility purposes.

There is no necessity for discussing the bearing of such an important omission by Mr. Dillman in making his valuation. The only question is, did he in fact omit to include this factor? There can be no doubt on this point. Thus he says, page 6549:

"Q. Then when Mr. Drinkhouse was asked to turn his property over to the Spring Valley Water Company, and they could not reach an agreement, and he was sued, it would have been proper for the jury, in your understanding, to have refused to have considered the possibility that Mr. Drinkhouse's part of that land would at some time be available for reservoir purposes and would be incorporated with the rest of the land and used for reservoir purposes, was it? Is that your understanding of it? A. I am not here to discuss the law points in connection with this reservoir, but Mr. Drinkhouse's land would not have been available for reservoir purposes if it had not been connected with some other lands, and therefore I think it would have been perfectly proper to have excluded any special value for reservoir purposes in that condemnation suit, and I think that is usually done in condemnation suits. I think the special use for which the land is sought—I think it is in some cases excluded by a jury from consideration in awarding damages.

"Q. You don't think Mr. Drinkhouse was entitled to have taken into consideration in that case the fact that this land, with other land, would have been useful for reservoir purposes? A. Well, I don't think so.

"MR. SEARLS: How do you mean, taken into consideration?

Do you mean taken into consideration for the purpose of arriving at the general market value, or in giving a special value for reservoir purposes?

"MR. McCUTCHEN: In arriving at a general market value, of course.

"THE WITNESS: I think that should have been excluded.

"Q. Do you think that should have been excluded? A. Yes."

And again, in his written paper, on page 6500 of the transcript, he says:

"Q. The right to condemn for reservoir or other public service uses limits the cost to what would be allowed by jury in condemnation. The owner is given the maximum value for all purposes. All the purposes that he can use these lands for are other than reservoir purposes. So, in the case of the Spring Valley reservoirs the maximum cost that would be allowed, or it would be proper to pay without condemnation, is the maximum value of the lands for grazing, agricultural, residential, and other uses, but does not include any consideration for reservoir purposes."

The fifth point that I desire to take up is Mr. Dillman's offhand condemnation of the San Antonio and Arroyo del Valle reservoir sites.

On direct examination he testified that he did not add to the so-called real estate value of either of these reservoir sites because he doubted their economical feasibility.

It is to be presumed that in a case of this character, and taking into consideration the fact that both the Arroyo Valle and San Antonio reservoir sites have been considered by a great many different engineers, and have been favorably considered, and have been discussed time and again in connection with the problems of the water supplies of San Francisco and the east bay cities, that an expert witness, in condemning those reservoir sites, would desire to be pretty well informed as to the basic facts connected with them before condemning them. Mr. Dillman, however, presumes to condemn them upon a mere visual examination, without

surveys and without information as to the basic facts which he admits would determine their economic feasibility. He condemns them, apparently, because there are reservoir sites in the Sierras where dams can be more easily constructed for the same amount of storage, assuming, apparently, that a reservoir site in the high Sierras is to be compared so far as cost and consequent economic feasibility is concerned, with a reservoir site within 50 miles of San Francisco.

The character of Mr. Dillman's testimony upon this point cannot be made clear without reading a considerable portion from it. I begin on page 6508 (direct examination):

"Q. Did you give your reasons for not adding to the real estate value of the Arroyo Valle and the San Antonio reservoirs?

"THE MASTER: He has given that.

"MR. SEARLS: Q. You said you did not consider their adaptability for reservoir purposes established, did you? A. Yes, sir.

"Q. Do you mean by that you have some question as to their economic feasibility? A. Yes; it is very doubtful if they will ever be utilized, in my opinion.

"MR. SEARLS: I think that is all."

* * * * * * * *

(cross-examination.)

"Q. What do you mean by economic feasibility? A. I don't think the reservoirs are worth building for the extension of this water works.

"Q. Why not? A. At present the flow-off is somewhat used through the wells and filter galleries and the cost is fairly high considered for this use. The demand for a water supply further off will further increase the probability of their never being utilized, and altogether I consider their utilization a matter of great remoteness if not altogether out of the question.

"Q. What would a dam at San Antonio cost? A. I have not made any definite estimates on those.

"Q. How much water could be impounded in that reservoir, if it were converted into a reservoir? A. The same answer.

"Q. How much would a dam at Arroyo Valle cost? A. The same answer.

"Q. And how much water could be impounded there? A. The same answer.

"Q. What then do you mean by saying that the quantity of water that could be impounded is not great enough to warrant the expenditure for converting those into reservoirs?

"A. I have examined in the last twenty years a great many reservoirs, a great many dam sites in connection therewith; these are not specially favorable dam sites and while they could be built and a great deal of water stored there the cost per acre foot of storage or per million gallons of storage would be higher than would be warranted. Now, I say that in a general way simply by comparison with other sites I have estimated on and have made definite figures on and not from any definite figures I have made on either of those sites.

"Q. That is to say, you would condemn those sites based upon your investigation of other sites? A. I have been on these sites. It is by comparison with other sites.

"Q. By comparison with what sites? A. With sites on the Stanislaus.

"Q. Are those sites on the Stanislaus available for supplying San Francisco and Oakland? A. They are just as available as Hetch Hetchy.

"Q. And you consider that they are a comparison for that reason?

"A. I probably did not express myself right. The comparison in my mind is the cost of storage per quantity stored; I have not considered these other sites that I have compared them with in any other connection except as to cost.

"Q. Well, you cannot have considered them with reference to cost, can you, Mr. Dillman, if you have no idea as to what it will cost to convert these sites into reservoirs?

"A. I don't say I have no idea; I say I have made no definite figures on them at all.

"Q. What is your idea as to what it would cost to convert Arroyo Valle into a reservoir?

"A. My idea is, compared with other reservoir sites that it would cost from $50 to $75 per acre foot for the Arroyo Valle.

"Q. What would that be for,—the dam? A. I don't know what the capacity is?

"Q. How long would the dam be? A. I don't remember; I have seen profiles of it.

"Q. How high would the dam be? A. That is a matter for future consideration; I don't think it is settled at all.

"Q. What would the water surface be? A. That would depend on the height of the dam.

"Q. Have you ever been there? A. Yes sir.

"Q. When? A. I have been there three or four times in the last ten years.

"Q. When were you there last? A. I was there last in 1914.

"Q. For what purpose did you go there? A. To renew my memory of the location.

"Q. It there more than one dam site on that stream? A. I think so.

"Q. Is there more than one dam site within the company's ownership? A. I don't know just where the company's ownership is.

"Q. You don't know then the property the company has in mind when it speaks of converting some of it into a reservoir, do you? A. Yes, I know where the proposed Spring Valley dam is, and where they made the excavations—the soundings there, exploring the site; I know where that is.

"Q. How would the cost of building a dam there compare, taking into consideration the quantity of water which could be impounded, with the cost of building a dam at the Calaveras?

"A. It would not be as favorable as at Calaveras.

"Q. How do you mean, as favorable? A. I mean that the cost per unit of water stored would be less at Calaveras than it is at Arroyo Valle.

"Q. How much water could be stored at Calaveras?

"A. I only know that from hearsay.

"Q. What is your information gained from hearsay as to the quantity that can be stored there? A. I would rather refresh my memory on that.

"Q. You did not refresh your memory before you fixed the value on Calaveras for reservoir purposes, did you?

"A. I think that Calaveras is worth developing.

"Q. But you did not refresh your memory as to the quantity of water which could be stored there before you fixed the value upon Calaveras for reservoir purposes, did you? A. No sir.

"Q. You did not consider that important? A. No sir.

"Q. Did you consider it important in the case of Crystal Springs?

"A. I only know what Crystal Springs' capacity is from hearsay.

"Q. Do you consider that an important element to be known for the purpose of arriving at the conclusions at which you arrived?

"A. The elements in cost of storage are the cost of construction and the capacity of the reservoir.

"Q. I didn't ask you that, Mr. Dillman. Repeat the question, Mr. Reporter. (Question repeated by the Reporter.)

"A. Yes, that is one important question.

"Q. Is it a very important question to be resolved in order to reach the conclusion which you reached?

"A. That is one of the two important questions.

"Q. Yet you did not know that when you reached a conclusion, did you? A. In a general way, I did.

"Q. You did not consider it of any importance to ascertain

that element in arriving at your conclusion with reference to Calaveras, did you? A. I didn't get the definite figures at Calaveras, although I have seen them.

"Q. Did you get any figures? A. No sir; it is not necessary to get those figures for these conclusions.

"Q. You stated a moment ago it was important to get those for your conclusions, did you not? A. It is important that those two things be known, the cost of construction and the capacity of the reservoir in order to determine the cost of the storage per unit stored, and it is that figure—an estimated figure in my mind which I have given, and I have not gone into further details in connection with either one of these storages.

"Q. What is that estimated figure as applied to Calaveras?

"A. The Calaveras storage in my opinion will cost a little bit more per unit than the storage at Crystal Springs; therefore it is not as good a storage as Crystal Springs. Arroyo Valle will cost—— .

"Q. Now, Mr. Dillman, will you be good enough to listen to my question: what was your estimate as to the capacity of Calaveras for the purpose of reaching that conclusion?

"A. I don't know now.

"Q. I will ask you again now: was it important that you should have known that in order that you should reach your conclusion?

"A. Not necessary at all.

"Q. Mr. Dillman, I have assumed you realize that in the one case you have said it was important to know that fact and in another case you have said it was not important; now, what is your position, that it is or that it is not important?

"A. The thing of importance in any case of that kind is the ratio of the cost of storage to the amount of storage.

"Q. If you don't know the amount of storage and you don't know the cost how do you determine the ratio? A. You don't

determine it exactly, but you determine it sufficiently to make that determination.

"Q. How did you determine it sufficiently?

"A. You do not have to go into great details in examining proposed storages to condemn a lot of them.

"Q. And you made sufficient investigation, did you, to condemn these? A. I did, in my mind.

"Q. Including Calaveras? A. I did not condemn Calaveras: I have probably said that Calaveras was probably worth making; I have never criticised the feasibility of its storage.

"Q. You state it was probably worth making? A. Yes.

"Q. Have you some doubt about it? A. Well, it is not as well worth making as Crystal Springs.

"Q. Have you some doubt as to whether it is worth making into a reservoir?

"MR. SEARLS: I think he has answered your question, Mr. McCutchen.

"A. No, I have no doubt about it; I think it is worth making.

"MR. McCUTCHEN: Q. Why then did you say it was probably worth making? A. Well, it is probably worth making, and probably my opinion is right.

"Q. But you are not certain it is worth converting into a reservoir? A. Not from definite figures of cost and capacity.

"Q. Should you have those in order to determine whether it is worth making into a reservoir?

"A. You would have to; if it was my business to settle the question I certainly should have those figures.

"Q. Should you have those figures, in your opinion, in order to determine whether the property was worth converting into a reservoir? A. No sir, if I had the ratio it would suit me.

"Q. But you have not the ratio? A. I think I have it sufficiently close to show what I have said.

"Q. What was it, as you have given it? A. I suppose the cost of storage there will be from $30 to $40 an acre foot.

"Q. How do you arrive at that, $30 to $40; you must have some basis on which to get at it? A. That is gotten from my experience and the examination of other sites that I have become acquainted with and on many of which I have made figures. That is all I have to base it on.

"Q. Tell us one of those sites that you have in mind?

"A. If you want me to give those I will have to have time to get at them. One of them, by the way, is a site that you are acquainted with, two sites that you are acquainted with—your company is, Gabbitt's Meadows and Speyer's Meadows on the Stanislaus.

"Q. Are they reservoirs or reservoir sites? A. Reservoir sites.

"Q. Have you any completed reservoir in mind from which you determined the reservoir? A. I can have; I think I have quite a little bit of data of that kind. I can get it for you.

"Q. Did you have when you arrived at these conclusions with reference to the value of these reservoir sites?

"A. I had them in mind in a general way but I did not use definite figures.

"Q. Then it is hardly correct, is it, to say you based this conclusion of $30 or $40 upon information which you had in other cases? A. I think it is correct.

"Q. But you cannot tell us what the cases are?

"A. My connection with these cases has covered a great many years of work, but offhand I don't know.

"Q. You spoke of some reservoir sites on the Stanislaus. Do you happen to know a reservoir on the Stanislaus that is popularly known as the Blood reservoir? A. Yes sir.

"Q. Do you know what it sold for? A. I know it sold for a great big price; I was told so.

"Q. To whom? A. I don't know; I think Jim Bishop was connected with that in some way.

"Q. Yes. You stated, in connection with reservoir sites on the Stanislaus, that your experience was they only sold for the value the land had for other purposes, didn't you? A. Yes.

"Q. Is that true of the Blood reservoir?

"A. I think that that was sold for a price that was greatly in excess of that, yes, but it never has been used for a reservoir and never will be; I believe that the men who bought it were swindled when they bought it for a reservoir site.

"Q. Do you know of the sale of any other reservoir sites in the Stanislaus? A. There is the Strawberry site, which is now being developed. That was not sold separately, that was sold with the old Tuolumne Water Company.

"Q. I want an instance of the sale of a reservoir site on the Stanislaus at a price not greater than its value for other purposes; that is what you said this morning, isn't it?

"A. I said that I examined sites there and that the prices put on them by the owners who desired to sell them was a maximum of $25 an acre, but there were no sales that I know of.

"Q. So you don't know of any sale on the Stanislaus except the Blood reservoir? A. Well, I didn't have that in mind.

"Q. Well, you do know of it now? A. Yes.

"Q. And that was sold at a price very much greater than the value of the land for other purposes? A. Yes, but the people who bought it were a bunch of suckers and they never will develop it.

"Q. Well, they were suckers a while ago, Mr. Dillman, and I don't know that it adds anything to it for you to repeat it."

* * * * * * * *

"A. (continuing) And when I was examining those reservoir sites on the Stanislaus I condemned that just as I condemned the San Antonio as being entirely not worth developing.

"MR. McCUTCHEN: Q. By the way, speaking of the San Antonio, how much water can be stored in the San Antonio?

"A. I don't know; I have seen estimates; I can get those.

"Q. Do you know whether there is ample water to fill it?

"A. I don't think there is.

"Q. Do you know anything about it? A. I have seen the reservoir sites; I have seen the runoffs. I don't think it is worth making.

"Q. Why? A. Because it will cost too much per unit of water stored.

"Q. But you cannot give the Master any notion as to what the cost will be? A. I can get those figures, yes.

"Q. But you did not have them when you arrived at these conclusions? A. No sir.

"Q. You did not have them when you condemned, to use your own words, the San Antonio site? A. I did not have them when I condemned the Blood site either."

The offhand and casual character of Mr. Dillman's condemnation of the San Antonio and Arroyo Valle reservoir sites is made too plain by this testimony to require any argument. It is hard to appreciate the mental attitude of a witness who, upon a point of such importance and one concerning which his opinion differs so radically from that of other engineers, expresses himself so positively, without any real examination into the merits of the matter. The impression as to the mental attitude of the witness which this testimony makes is heightened by his loose and ill considered testimony that a proper method of valuing reservoir land is either to take their original cost and add 5% per year simple interest, or else to take their present value for agricultural, grazing or suburban purposes and add 25% not as representing their true market value, when their peculiar suitability for reservoir purposes is taken into consideration along with their other elements of value, but as representing something else which he fails to define with any clearness or exactness and which in one part of his testimony is one thing and in another part is something very different.

This impression is also heightened by Mr. Dillman's testimony

that the peculiar suitability of these reservoir sites for reservoir purposes should not be considered as an element in determining their market value. This is a question of law pure and simple. The rule to the contrary is thoroughly well established. It has been the subject of discussion in this case time and again. How did it happen that Mr. Dillman did not inform himself about so fundamental a proposition before going on the stand? I think I am not too severe in saying that it bespeaks the mental attitude which expresses in terms of great positiveness and certainty hasty, casual, and ill considered opinions.

My last point in connection with Mr. Dillman's testimony is that at least those portions of it which are concerned with valuing the reservoir sites are not merely untrustworthy but are legally incompetent. The method which he advocates of taking original cost and adding 5% per annum, simple interest, for the time the property has been held by the public utility has no possible justification. It conforms to no rational theory for determining the value to be allowed for rate-fixing purposes. His figures are not original cost, they are not reproduction cost, they are not present value; they are figures arrived at by a theory and method which the law does not recognize, and are not merely of no significance but are not properly admissible in evidence.

The same thing is true of his testimony that it would be fair to add 25% to the present appraisements. Mr. Dillman makes no claim that this represents his judgment as to the amount which should be allowed in order to arrive at the true market value of the property. The best that can be said for it is that it represents his judgment as to the probable cost of reacquisition. If this is true, it is simply a case of taking present value and applying a multiple to get the probable cost of reacquisition, a method that, perhaps, has some logical justification, but which was, nevertheless, declared incompetent in the Minnesota Rate Cases.

Summing up this matter of reservoir values, there is before the court competent testimony of only two witnesses, Mr. Grunsky

and Mr. Cory. I do not urge that, by reason of this fact, their testimony must necessarily be accepted as conclusive, but I do urge upon the court that it is not contradicted and is entitled to the weight which is due to that fact.

I further urge upon the court that these two gentlemen were peculiarly qualified to form a reliable opinion,—Mr. Grunsky as to the value of all the water company's reservoir sites, and particularly those on the Peninsula, and Mr. Cory as to the value of those across the bay.

I further urge upon the court that they both approached the problem by the right method and that if there is any question as to the correctness of their conclusions the doubt lies, not in their method of approach, but merely in the final judgment which they have applied to the various factors which enter into the problem.

I further urge upon the court that, particularly in the case of Mr. Grunsky, the conservative character of his mind was apparent, and it was also apparent that his opinion was conservative from his own point of view.

I further urge upon the court that the results reached by these two gentlemen are results which commend themselves to our own judgment, in view of what we have learned in connection with this case and of what we know as matters of common knowledge. Mr. Grunsky's total figure for the reservoir lands on the Peninsula, some 2,740 acres, including 740 acres of land at Crystal Springs not yet flooded, is $3,388,000. When we consider the character of the three reservoir sites involved in this valuation, their very decided suitability for the purpose to which they are put, the fact that they are the only sites at all suitable close to San Francisco, and on the same peninsula with it, and the imperative necessity for their utilization, it seems wholly reasonable that if these sites had existed, unutilized, on December 31, 1913, and in one ownership, so that they would be immediately available for use, a sum of $3,400,000 at least could have been obtained for them by the owner, particularly if he owned the watershed lands also and

would dispose of them at the same time and upon the basis simply of their value for general purposes.

RIGHTS OF WAY.

MR. OLNEY: I desire to speak briefly on the matter of rights of way. The appraisement of rights of way made by Mr. Radle totals approximately $975,000; from that there are certain small amounts to be deducted on account of duplication arising from the fact that in the rights of way were included properties owned by the company in fee which were appraised separately by the real estate experts. The same reduction is necessary in the case of Mr. McDonald, the appraiser for the city; he also has included in his figures certain tracts of land which were appraised by the real estate experts and in order to avoid a duplication the valuations which he has put on those tracts should be deducted from his figures.

As I have said, Mr. Radle's total valuation is in the neighborhood of $975,000; Mr. McDonald's total valuation is $272,000. The difference between the two appraisements lies almost entirely in four particulars.

First: Mr. Radle has appraised the right of way through the cemeteries upon the basis of what it would cost now to go in and purchase such a right of way from the cemetery corporations; Mr. McDonald has appraised the rights of way through the cemeteries either upon the basis of their original cost, as he did in the case of the Cypress Lawn Cemetery, or else upon the basis of the value of adjoining land not within the cemeteries, adding in some cases a percentage to such value and in other cases not adding any percentage at all.

This is the largest item of difference between them; it will run somewhere between $500,000 and $600,000; that is, we have a difference here altogether of about $700,000 in their valuations and of that sum between $500,000 and $600,000 is attributable to this matter of cemeteries. For instance, on the San Andreas,

College Hill line the difference due to cemeteries is $118,000. On the San Andreas, Baden to Merced line the difference is $487,000, making, as you will see, practically $600,000 in those two items.

I have been in considerable doubt as to just what to say about this difference for the reason that it would appear like putting an extraordinary high value on rights of way to allow as the value the amount which the company would necessarily have to pay if it would reacquire these rights of way through the cemeteries. On the other hand, however, are the facts that the company actually has the right of way across those properties and that they have the actual values which Mr. Radle put upon them. In this connection I would say that Mr. McDonald's figures as to cemetery values as such do not differ from Mr. Radle's.

The application of the principle laid down in the Minnesota Rate Cases will, in most instances, necessarily result in a value being placed upon the right of way very much below what it originally cost the public utility to acquire it. The situation here is, of course, just the contrary, and in that respect is exceptional. Valuing the right of way on the basis of the value of adjoining land results in a figure very greatly in excess of what the property originally cost the company. It would seem, under these circumstances that if the company is to suffer in most instances by reason of the application of the principle announced in the Minnesota Rate Cases, it is not unreasonable to give it the advantage of the application of that principle in an exceptional case like the present, where such advantage exists. At any rate, it would seem to me the company should have a very considerable portion of that advantage. The situation, in brief, is simply that the company has actually got this right of way, that it was reasonably acquired at the time it was acquired, and that it now has the actual value which Mr. Radle has placed upon it.

The second point of difference—substantial difference—between

Mr. Radle and Mr. McDonald lies in this: in quite a number of instances the company years ago acquired a private right of way across private property and laid its pipe line; subsequently the property was subdivided and put on the market and when the owners came to subdivide it they located streets along the line of right of way so that now the pipe while originally across private property now actually lies in a public street. There can be of course no question in such a case but that the company actually has a private right of way along the line of its pipe line which is superior and prior in right to the dedication of the property as a public street. In those cases Mr. Radle, under instructions from the attorneys for the company, valued that right of way, that private right, upon the basis of what it would cost to secure it if the public street were not there; that is to say, upon the basis of the value of adjoining land. Mr. McDonald, on the other hand, valued it upon the basis of allowing the company simply what the right of way originally cost, where he could ascertain that cost, and allowing nothing for it where he could not ascertain the cost. It seems to me clear, however, that the method which Mr. Radle followed was the proper method. There can be no question about the fact that the company has actually a private right. Mr. McDonald assumed that the company could lay its pipes now in the public streets. That assumption I think is without warrant. He assumed that the company could get a franchise. He does not know whether the company could get a franchise, or not, or, if it could, upon what terms it could get it. The fact is the company actually has a private right of way, and if the company had to lay another line the only method by which it could be certain of securing the equivalent right of way would be one through private property adjoining a public road. They would there have the right of condemnation and could go through with it, but they would not have the right to lay the pipe line in the public streets. In view of this fact and in view of the fact that the company actually has an estate or

interest of a private nature there, it seems to me the right of way should be valued upon the basis that Mr. Radle has valued it.

In connection with this matter of obtaining a franchise, or the possibility of obtaining a franchise, I will call to your Honor's attention that in practically every case of the kind that I have mentioned the public street is without the limits of San Francisco and is either a county road in San Mateo County or else is within a municipality to which the company is not supplying water. That I think would have a most direct bearing first on the right of the company to obtain a franchise and, in the next place, on the possibility of obtaining one.

MR. SEARLS: Do you think the Russell case decision would not apply there?

MR. OLNEY: I don't think it would.

The third point of difference between the two appraisers lies in this: in certain places, I think in each instance within the city, or at any rate very close to the San Mateo line, the pipe line runs just within the property line of private property; in other words, it is following the general direction of a street, but instead of lying in the street lies within the property line and on private property. I say that it lies on private property but in one or maybe in two instances the private property of which I speak is, if I may use an Hibernianism, public property in the sense that it is a park. The property however is not public property dedicated for street purposes. Mr. McDonald in all of these cases allowed nothing for the value of this right. Mr. Radle appraised it upon the basis of its being a private right, as undoubtedly it is, and upon the basis of determining as nearly as possible what it would cost to go through there. Here again it seems to me that Mr. McDonald's method of valuation is not sound and that the method pursued by Mr. Radle should be followed. There can be no question but that the company has the right to a private right there; there is no conflict in the evidence as to what that private right in and of itself is worth, there is no difference between Mr. McDonald and Mr. Radle in that respect. Mr. McDonald's proposition is that if

the company came to lay a new pipe line there, or had to acquire the right to lay a pipe line it would do so by means of a franchise along the public road, that is, change the location of this pipe line and adopt another along the public road. It seems to me it is clear that that would not be a proper method to follow in reaching a valuation here. There are manifest advantages in having a private right of way and there is no certainty whatever that the company could obtain a franchise.

THE MASTER: Are not those cases all within the city?

MR. OLNEY: Most of them are within the city.

THE MASTER: You don't need a franchise for that, as I understand the law.

MR. McCUTCHEN: You have to have an authorization from the Board of Supervisors to lay your pipe.

MR. SEARLS: Oh no.

MR. GREENE: No, not under the Russell case.

MR. SEARLS: I think the Russell case would apply clearly within the City and County of San Francisco.

MR. McCUTCHEN: I thought in that case they held you had to get a permit.

MR. SEARLS: The only permit you have to get is a permit from the Board of Public Works to open the street, and that is purely a formal matter.

MR. OLNEY: A very large portion of this particular item is concerned with Balboa Park and I think Union Park, as to which of course the company would have to obtain the right from the public authorities. I will have tables presented showing the exact situation in that respect.

THE MASTER: Aren't those parks within the City and County of San Francisco?

MR. OLNEY: Yes, those particular ones are, your Honor.

MR. SEARLS: They are in the Mission District.

MR. OLNEY: The fourth difference between Mr. McDonald and Mr. Radle consist in this, that as the pipe lines approach the

City and County of San Francisco they run in many instances across subdivided property, property that has been subdivided and is held in small lots, 25 and 50-foot lots. Mr. Radle valued the right of way across these lots or through these subdivisions upon the basis that it would be necessary for the company in acquiring the right of way through property of that character to buy in each case a lot that was crossed; that was his experience in purchasing rights of way across small pieces of property, that the amount you would have to pay for an easement would be at least fully equal to the value of the lot and that the only practical way was to buy the land. Mr. McDonald, on the other hand, valued simply a 10-foot strip in general through these subdivisions and valued that without any severance damage and simply by applying a per square foot value on the lot and then giving to the easement the proportion of that value which would be actually taken up by the 10-foot right of way which he assumed.

I think Mr. McDonald's testimony can be taken as practically amounting to this, or as coming very close to conceding at any rate that in case it were necessary to reacquire this right of way it would be necessary to buy the lots that were crossed. At any rate I think there can be no doubt but what that would be the actual situation, that if any water company or any public utility were going to buy a right of way through property of that character it would have to buy each small lot that was crossed. What makes that necessary is the fact that the value for each particular lot is so small that bringing a condemnation suit and pushing it to trial as to individual lots is out of the question. The amount on any particular lot so far as the actual amount paid to the owner is concerned would be perhaps $500—if the jury were absolutely fair, but that $500 would not begin to represent the cost of the proceedings. The result would be in such cases as that that the company inevitably would buy the lot. Here again it seems to me that Mr. Radle's method of valuation is the correct one.

I don't know that I have anything more particularly to say or that I can elucidate the matter any further for your Honor. The basic figures of value of Mr. Radle and of Mr. McDonald—

MR. SEARLS: You have omitted to discuss one feature, Mr. Olney, and that is with regard to the assumption of width. Mr. McDonald assumed the same width the company has and Mr. Radle assumed 25 feet where no width was mentioned.

MR. OLNEY: There is that difference, Mr. Searls, but it does not run into much money except in the case of the lots of which I have been speaking and there of course it practically makes no difference. I can state very briefly our position upon that point: the difference between the two witnesses arises from this fact, that in quite a number of instances there is no specified width for the right of way; the company has a right of way for its pipe line without a specified width. Under those circumstances of course the law is clear to the effect that the company has as an incident of the right of way the right to use as much of the adjoining property as is necessary for the construction and maintenance of its pipe line; in other words, the amount of property that is dedicated under those circumstances to the public use is the amount that is necessary for the maintenance and construction of the pipe line. Mr. Radle testified that in his experience a width of at least 25 feet was necessary for that purpose. My impression is that Mr. Hazen or Mr. Metcalf testified to the same effect.

MR. SEARLS: Mr. Hazen used even a wider strip, I think.

MR. OLNEY: Mr. McDonald followed this principle: He took in these cases of indeterminate width the width as being that specified for some near portion of the right of way. Putting that a little more clearly, the width of the right of way of the company was in many cases specified; if adjoining such a case as that Mr. McDonald found an instance where it was not specified he applied to the latter case the width which was specified in the first case, and as a general rule if there was any doubt about the matter he prescribed a width of 10 feet.

The testimony upon that point I think clearly showed that 10 feet was not sufficient for the maintenance of construction of the pipe line, and that, as a matter of fact, where there was an indeterminate width the right of the company extended further—extended to at least 25 feet. If that is the situation and if that is the truth, then that being the right of the company, the right of way should be valued accordingly. As I say, however, I am quite certain that does not run into very much money, with the exception of the right of way through these small lots, and there Mr. McDonald has uniformly, as I remember it, assumed a width of 10 feet while Mr. Radle and the company take the position that it would be necessary to acquire the whole lot.

MR. SEARLS: There are some considerations with reference to the company's title, Mr. Olney.

MR. OLNEY: We claim that a public utility corporation when its pipe line is in without objection on the part of the owner secures by those facts alone as complete a title as if it actually had a grant from the owner. The absence of a grant makes no difference whatever in the character of the title under those circumstances. The title is complete. In all of the instances where that question arose the pipe had been in for years.

THE MASTER: Mr. Greene, on your table numbered 68, where you summed up the reproduction cost of the plaintiff's properties, you have rights of way specified at $613,000; where did you get that figure?

MR. GREENE: That is a figure Mr. Metcalf used and it covers the rights of way which were not considered by Messrs. Baldwin and Hoag as real property in the Peninsula. The distinction should thus be drawn between the amount which is stated there, which is really only a portion of the real property owned by the company and considered as rights of way and the total figure which Mr. Radle uses and which includes the $613,000 named there and the figures stated by Messrs. Baldwin and Hoag for other properties.

THE MASTER: Then $613,000, plus instances in which Radle

and Baldwin and Hoag duplicate each other would make up $900,000 odd—is that the idea?

MR. GREENE: Mr. Sharon makes one further correction to what I said, your Honor, and that is that Mr. Metcalf took in his figures, which are the figures used there, the original cost of the Baden-Merced branch instead of the reproduction cost figures.

THE MASTER: Well, I don't suppose that it is of any significance anyway.

MR. OLNEY: Your Honor, that is all I have to say on this matter. I would like to ask leave to prepare the tables showing the specific differences along the four points I have indicated. I think Mr. Searls might find on examination that the two points he has mentioned do not run into very much money and I have not deemed it worth while to take up your Honor's attention with them.

MR. McCUTCHEN: Will your Honor permit a suggestion? What I had in mind when I suggested that it would be necessary to obtain a franchise from the city was this: We are talking now about the reproduction of this plant as of 1913 and I take it that any company beginning in 1913 would be required to obtain a franchise from the city in order to lay pipe in the streets and that without such a franchise it would not have a right to lay it. That amendment was passed in 1912.

MR. SEARLS: The amendment was on October 10, 1913, I think—I think that is the date when it was approved by the people.

MR. McCUTCHEN: I thought the amendment was in 1911 and that it was ratified in 1912; that is my impression.

MR. SEARLS: Well, that question would go to the entire franchise question and you have not raised that yet. If the franchise is to be reproduced it would have to be reproduced for everything; if you are not going to have a franchise, you would not need one in this case.

MR. McCUTCHEN: I was only suggesting that in connection with Mr. McDonald's claim that it would not be necessary to get

these private rights of way but that the company had or could get a franchise to lay the pipe in the public streets.

MR. SEARLS: At the time the pipe was laid the company operated under the state law and didn't have to pay anything for a franchise anywhere so far as the records we have been able to find disclose. Our contention against franchise inclusion is based largely on that fact. There has not been any evidence in this case as to the cost of reproducing the franchise.

MR. McCUTCHEN: I am not suggesting that on the theory that we are entitled to a value for the franchise.

THE MASTER: I had forgotten, Mr. McCutchen, that the constitution had been amended since I practiced law.

MR. OLNEY: We are not contending for any valuation for the franchise at all. Mr. McDonald says we could have obtained one and for that reason he proposes to reduce the value of the private right of way.

RECONCILIATION OF VALUATIONS OF McDONALD AND RADLE ON RIGHTS OF WAY.

Pipe Line from Crystal Springs Reservoir to University Mound Reservoir.

Deducting from McDonald's valuation of $29,361.65 items 38, 40, 42, 44, 46, 48 and 50, being valuations of pieces of property in San Francisco whose valuation is included in the agreed values of Baldwin and Paschel and totaling $14,647, leaves as the net valuation for McDonald's appraisement $14,714.65.

The difference in valuation due to the fact that Radle has valued private right of way in what is now a public road, but was formerly private property, upon the basis of the value of adjoining lands, and McDonald has allowed simply cost in those instances where he could ascertain the cost and otherwise has allowed nothing, is $22,370. Deducting this from Radle's total valuation of $37,352 leaves as his valuation, exclusive of this difference, $14,982, as compared with McDonald's valuation of

$14,714.65. The tabulation of differences on what we may term private right of way, now a public road, is as follows:

Item	McDonald	Radle
9	$500	$10,547
10	)	10,620
11	).. 500	851
12 (P. R. W.)	)	1,262
21		79
22		502
24	90	30
33		215
56	884	238
	$1974	$24,344
		1,974
Net difference		$22,370

Pipe Line from San Andreas Reservoir to College Hill Reservoir.

Items 5 and 105, valued by McDonald at $3271, should be omitted from his total as duplication. Item 5, valued by Radle at $5476, should be omitted from his valuation as duplication. Making these deductions leaves as McDonald's valuation $25,238.30 and as Radle's valuation $200,518.

Differences.

(1) Radle has valued private right of way in what is now a public road at $13,945. McDonald has allowed nothing for this.

(2) Differences in cemetery valuations.

Item	Cemetery	McDonald	Radle
13	Holy Cross	$1,236	$9,174
14	Holy Cross	900	6,667
15	Holy Cross	1,308	9,690
33	Mt. Olivet	1,824	98,317
		$5,268	$123,848
			5,268
	Net difference		$118,580

(3) Items 83, 85, 87 and 90, McDonald valued at nothing on the ground that in these cases the pipe line was immediately inside the property line, and that if a new pipe line were to be constructed, it would be constructed in the public street. Radle has valued these items on the basis of values of adjoining property at $6240.

(4) In cases where pipe line right of way crossed small lots Radle valued the right of way as that of the lot, on the ground that it would be necessary in order to acquire a right of way across such a lot to purchase the lot. McDonald has valued the right of way in such instances upon the basis of taking merely an assumed width for the right of way and valuing the area therein included. These differences tabulated are as follows:

Item	McDonald	Radle
40	$ 378.40	$1,250.00
42	512.60	1,800.00
44	514.80	2,400.00
46	334.40	2,500.00
47	612.00	3,850.00
49	1,344.00	5,400.00
53	868.00	5,935.00
55	1,158.00	5,900.00
58	204.00	500.00
60	202.00	250.00
77	522.00	600.00
79	412.80	888.00
81	738.00	1,672.00
92	414.00	2,555.00
97 (97, 98 and 99)	408.00	1,300.00
99 (101)	92.80	498.00
100 (102)	612.00	1,750.00
102 (104)	294.00	575.00
	$9,621.80	$39,623.00
		9,621.80
Net difference		$30,001.20

Summation of Chief Differences on Line from San Andreas to College Hill.

Private right of way in what is now public road	$ 13,945.00
Cemeteries	118,580.00
Right of way immediately inside property line	6,240.00
Right of way across small lots	30,001.20
	$168,766.20
Total difference	175,279.70
Differences not accounted for above	$6,513.50

Baden to Merced Branch of San Andreas Pipe Line.

The differences are almost entirely in the valuations on the right of way through cemeteries. These items tabulated are as follows:

Item	Cemetery	McDonald	Radle
8	Cypress Lawn	$20,153.12	$161,297.00
12	Greenlawn	3,808.50	138,260.00
13	Woodlawn	6,000.00	217,800.00
		$29,961.62	$517,357.00

or a difference due to this item alone of $487,395.38. Deducting this difference from Radle's total valuation of $574,763 leaves $87,367.62 as compared with McDonald's valuation of $92,096.02 with the difference in cemetery valuation eliminated.

Alameda Pipe Line.

On that portion of the Alameda pipe line from Pleasanton to Sunol McDonald's total valuation is $4,012, Radle's $4,822, and on that portion from Sunol to the Millbrae pumps McDonald's valuation is $31,175.80 and Radle's $34,771. The difference in the latter case is largely due to difference in the valuation of private right of way now in public road.

(a) Pipe and Flume Line from Lower San Mateo Creek Dam to San Andreas.

(b) Flume Line from Crystal Springs Pumps to San Andreas.

(c) Pipe Line from Lake Merced to Lake Honda.

The rights of way across lands not owned by the company for a flume and pipe line from the lower San Mateo Creek Dam to the San Andreas Reservoir, and also the rights of way across lands not owned by the company for a flume line from the Crystal Springs Pump Station to the San Andreas Reservoir are valued by McDonald and Radle on pages 29 and 30 of their respective reports, but these valuations are run in to the valuations on the pipe line from Lake Merced to the Lake Honda Reservoir, so that they are included in the totals of the latter line, and in the grand summation at the end of each report, are included in the item entitled Pilarcitos Pipe Line. These rights of way are, of course, wholly distinct. On the first two mentioned rights of way the figures of Radle and McDonald are identical, and the item in the grand summation "Pilarcitos Pipe Line" should, accordingly, be broken up as follows:

(a) Right of way across lands not owned by company for pipe line and flume from lower San Mateo Creek Dam to San Andreas Reservoir:

McDonald	Radle
$1125	$1125

(b) Right of way across land not owned by company for flume line from Crystal Springs Pump Station to San Andreas Reservoir:

McDonald	Radle
$6129	$6129

(c) Pipe line from Lake Merced to Lake Honda:

McDonald	Radle
$29,617.75	$63,648.00

Items 19 and 27, valued by Radle at $1188 and $357, respectively, or a total of $1545, and omitted by McDonald, should be omitted from Radle's valuation as duplication, the same consisting of parcels owned in fee and valued by the real estate experts, reducing Radle's total valuation to $62,103. For the same reason there should be deducted from McDonald's figure the valuation on item 69 of $1250, reducing his valuation to $28,367.75.

For a portion of the distance (items 13 to 17) this pipe line is across the Lake Merced lands. This portion of the right of way has been valued by both McDonald and Radle at a total of $12,798.50.

The valuation of the right of way across these lands was made under instructions from the attorneys in view of the contention of the city that these lands should not, as a whole, be considered as in use. If the Master concludes that they should be considered as in use, then, in order to prevent duplication, the above amount of $12,798.50 should be deducted from both Radle's and McDonald's valuations, leaving as their total figures for the right of way for the pipe line from Lake Merced to Lake Honda, outside of the Lake Merced Ranch:

McDonald	Radle
$15,569.25	$49,304.50

or a difference of $33,735.25.

This difference is due almost entirely to three things:

First, McDonald, in those instances where the pipe line crosses small lots, has made his valuation upon the basis of computing the per square foot value of a right of way on the assumed width of ten feet, while Radle has made his valuation upon the basis that it would be practically necessary for the company, if it were to re-acquire such right of way, to purchase the entire lot. The differences in this respect computed are as follows:

Item	McDonald	Radle
30	$ 533.15	$2,800.00
32	464.00	2,150.00
34	228.00	1,050.00
35	222.00	700.00
37	450.00	1,200.00
39	50.00	298.00
41	240.00	1,000.00
44	300.00	1,650.00
46	300.00	500.00
48	300.00	500.00
50	300.00	500.00
52	300.00	400.00
54	300.00	400.00
56	300.00	400.00
60	225.00	270.00
62 (62, 63, 64)	992.00	3,170.00
64 (66, 67, 68)	980.80	4,200.00
66 (70, 71)	404.80	2,714.00
68 (73, 74, 75)	972.50	5,800.00
	$7,862.25	$29,702.00
		7,862.25
Net difference		$21,839.75

The second substantial point of difference between McDonald and Radle is in their valuations on the right of way across the old Sutro property, that is, from Ocean Avenue to the Lake Honda Reservoir, shown on page 35 of the volume of Maps of Properties. The basic values of the property crossed are the same, $4,000 an acre (see items 71 to 78 of McDonald and 78 to 85 of Radle). McDonald, however, assumes a ten foot width and Radle a twenty-five foot width. Radle's total valuation on this basis is $16,974 and McDonald $7375, or a difference of $9599.

The third point of difference is this: The last portion of this right of way, McDonald item 78 and Radle item 85, consists of some 2806 feet of right of way for tunnel. McDonald has valued

this at $500, saying that he did so largely on the experience of the city in purchasing rights of way for the Twin Peaks Tunnel. Radle has valued it on the basis of a ten foot right of way, or a total of $2575, a difference of $2076.

Recapitulation of Differences.

1.	Right of way across small lots	$21,839.75
2.	Difference in assumed width across old Sutro lands	9,599.00
3.	Tunnel easement	2,078.00
	Total	$33,516.75

The differences in value on the remaining rights of way are not substantial.

GROSS REPRODUCTION COST OF STRUCTURES.

MR. GREENE: I shall take up now, if your Honor please, the gross reproduction cost of structures by groups. I have some preliminary comment to make before I get to the detail of that discussion.

The determination of reproduction cost is, perhaps, the most important single element of consideration in the valuation of such a public utility property as that of the Spring Valley Water Company. For its proper application, however, two preliminary propositions must be established; first, that there is a demand for the water which the utility offers for sale; second, that the works have been constructed with a due regard to economy and use.

THE MASTER: In other words, you predicate that upon a normal plant?

MR. GREENE: That is what I have in mind.

As to the first point, both the principle and the facts of this case are clear. Just as no water plant is valuable unless there is a demand for the service, so the actual consumption in San Francisco demonstrates the existing demand during the years in controversy. It is further pointedly emphasized by Grunsky,

Cory, Wadsworth and O'Shaughnessy. The answer to the second question is equally apparent. Hazen says (4285):

"The design of the structures is good. I have never examined an old system of water works which showed such continuity of purpose as is shown by the works of this company. The metal was well arranged in the pipes; the riveting was good; the thicknesses were closely calculated, and were strong enough to do the required work, as is demonstrated by the very small number of breaks. The figuring was very close; the metal was stretched about as far as it was safe to go. The reservoirs and dams were well built, and the tunnels are of good workmanship. The distribution system is well designed and of good material. The works were laid out with a view to future development, and the whole system has been planned so that added units could be built and worked into the system as required. The number of structures which have been discarded during the years gone by I think is low. That has been due partly to the fact that the structures have been very durable ones, and in part to the fact that the design has been carefully arranged to anticipate growth, and to serve for a long period."

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(4286) "The works are capable of long future service, for the most part, in very good order."

Dillman says: (7429)

"A public corporation that can contract their work, as a rule can contract it to better advantage than they can do it themselves. It is always advisable to do it. I think as near an exception to that as I know it in a large way has been the work of Hermann Schussler; while I think that he might have paid more for some of his work, it was because of an attempt to get really better work."

* * * * * * * *

(7416) "His work was always exceedingly good, and I am a great admirer of his methods of doing work, and I consider that as a general thing he was right."

Dockweiler says: (4527)

"I think the Spring Valley coating is the best coating made in the United States."

* * * * * * * *

(8033) "The Crystal Springs dam I consider will be used as long as water is being supplied to the city of San Francisco. * * * Experience has demonstrated the success of the method of constructing the Crystal Springs concrete dam."

* * * * * * * *

(8034) "The San Andreas and Pilarcitos dams I consider have the same degree of permanency as the Crystal Springs concrete dam. They have been tried; they are better now than when first built."

* * * * * * * *

(8036) "I consider that the cast-iron pipes in the city of San Francisco have not only the possibility, but the probability of the longest life of cast-iron pipes of any city that I know of."

He gives similar approval to the riveted pipe in the system. Referring to pumping stations, he says: (8044)

"I have observed these pumping plants for the past 12 years, and listened to criticisms of them, and this fact always confronts you, that the stations have performed their duty; there has been no breakdowns; while the pumps have been built heavily, the extra metal which has gone into them has not cost much, and has fully justified the design of the man who created them."

Of flumes, he states: (8048)

"They are built of the best of material, and they are built in such a way that they make for the longest life possible."

The quality of the water is conceded to be excellent (1319).

On these points there is a remarkable agreement that the plant was well conceived, well constructed, and well operated. So far as we have been able to find, the only exception to this statement was the criticism of O'Shaughnessy that there had been areas of low pressure and other areas without connections. He had no

data to support his statements either that 25 per cent of the area of the city was in districts for which the supply was insufficient, or that "possibly 10 per cent of the consumers were affected." (10787.)

Hazen was examined on this subject and stated that in parts of the city the pressure had, at times, been inadequate.

Elliott showed where the trouble had been and its extent (11011).

O'Shaughnessy's suggestion that extensions had not been made to certain possible consumers has no place in this proceeding. We are valuing the plant as it exists, not a hypothetical plant with added conduits and mains; a plant performing the service this plant has performed, not another or a different service. O'Shaughnessy's criticisms in no way affect the application of the reproduction cost method of valuation.

That method is not necessarily of controlling importance. But it is generally the most useful standard of value. In these proceedings is has been assumed to include:

(a) Real Estate,
(b) Structures,
(c) Water Rights,
(d) Development Expense or Going Concern Value,
(e) Stock on Hand,
(f) Working Capital.

THE MASTER: I would like to clear up one query which arose in my mind yesterday: at page 567 of the argument you refer to the reproduction cost method of valuation as "not necessarily of controlling importance but it is generally the most useful standard of value." You then went on to say "in these proceedings it has been assumed to include—

(a) Real estate;
(b) Structures," etc.

Do you mean to apply the reproduction method valuation to real estate?

MR. GREENE: I shall take up the reproduction cost method of real estate when I come to take up the entire discussion of reproduction cost and I will suggest at that time that if we are going to apply the reproduction cost method as a yard-stick, to use Mr. Metcalf's term, we have to consider overhead on land as well as on structures in reaching that determination, and I shall attempt to show that the Minnesota Rate Cases do not controvert that contention.

THE MASTER: As you said on the opening day, the effect—if you use market value for the lands without such additions to reproduction cost—produces a hybrid. I am inclined to think that the hybrid method is the usual method.

MR. GREENE: It may well be, your Honor.

This chapter is limited to a discussion of the gross reproduction cost of the structures.

Structural values were discussed at the hearings in major groups in order that the court might have in hand substantially all of the evidence to be submitted upon any single group of property before the next group was taken up. This novel method of trial proved very advantageous, and will be followed in this argument, as it lends itself best to an intelligent discussion of the evidence adduced.

We shall first discuss the methods of making a reproduction cost estimate, and then analyze the evidence upon the major structural groups.

The general method of making an estimate of reproduction cost was so admirably outlined in the testimony of Hazen, plaintiff's principal witness upon reproduction cost of the property of the Spring Valley Water Company, that it is abstracted here:

"In connection with the appraisal the first business was estimating the cost of reproduction of the works in the whole system. With the aid of the works, plans and inventory, I made an estimate of what was the fair cost of reproduction of the whole system

as of January 1, 1914, taking into account the prices that were current, and had been current for supplies and labor for a few years prior to that time, particularly the prices that ranged in the period from 1907 to 1914. In the case of some construction work done within the last few years, I checked over the cost and found it was reasonable. I used the actual cost of construction as reported as the best evidence of the cost of reproduction at the present time, and I wrote the figures into my schedule for some such items. The older records (4288) of cost I gave such weight as they seemed to deserve, but the farther back a cost record is in point of time, or changes in condition, prices and labor, the less consideration I gave it in making up the estimated cost of reproduction.

"In making my appraisal I drew on all the experience that I had, and the sources of information and experience that were used necessarily varied very much for the different items. I used whatever seemed to be most appropriate and best and reliable for each kind of structure as it came up. Fair reproduction cost is an amount for which the plant, under good average management, can be built, at prices that yield fair compensation or fair profit to everyone who contributes to the construction of the plant. The prices of labor and material fluctuate from time to time. In the 20-year period there has been more than a two to one ratio between the minimum and maximum cost of iron products, covering cast-iron and steel. In the decade of the nineties labor costs were very low, but in the last year or two of that decade, and beginning with 1900 and the years that followed there was quite a boom and the price of labor went up very rapidly. Since that time there has been a continued increase in the price of (4289) labor. The other materials have fluctuated, sometimes going up and sometimes going down.

"In making my valuation I take into account the improvements in doing a given piece of work over what they were when the work was actually done in the first instance. I assume that

the work will be done in whatever manner is most advantageous at this time.

"The cost of reproduction less depreciation does not necessarily govern the final determination of values in a case involving rate fixing (4290). It is to me perhaps the most important single element, but certainly not in itself controlling. Different engineers have different methods in which to make an appraisal of property of this character. I go at it exactly as I would do if the property did not exist, and the problem was to find out what it would cost to build it. I take into account all the experience I have had, especially the cost of building similar works, or as nearly similar as may be to those that are to be estimated on, and I take into account the differences in the labor condition; the conditions of cost of materials as affected by freight and otherwise; conditions of climate, and all the conditions that there are that influence the cost of construction, and increase or decrease it above what it has been in the case of work for which I have information, and which I use as a basis in forming a judgment as to what it will cost to produce these works. Ordinarily I disregard the original conditions; the estimate relates to conditions (4291) of the present time. When I speak of the changes in climate, I mean that if I built a dam somewhere else, and know the cost of it, and I think that it has some bearing on the cost of the dam here, it may be very useful information, but it is not information that can be transferred bodily. It has to be modified by estimates for all the differences that there are as far as I can find out about them and allow for them.

"In my opinion quotations of material play very little part in work of this character, and it is my experience that they are not reliable; they are apt to be quotations for different kinds of material than those that have been used in the plant. I ordinarily place very little importance upon quotations from manufacturers, either in estimating the reproduction cost of a plant, or in estimating on new work, as I do not ordinarily regard that as a reliable

basis. The prices at which other work of a greater or less similarity have been done, play some part, and are often quite important. They have to be taken with a good deal of allowance, with knowledge of the conditions, and as to whether the contract prices were adequate or not. In nearly all cases (4292) there is extra work not governed by the contract, and it is very common for the final estimate that the engineer makes to the contractor for the settlement of his work in the end to differ quite a good deal from the price at which the contract was let. Contract prices are helpful, but they are not as safe a basis as the records of the cost of finished work.

"Somewhat different problems are presented in building small works than in building large ones. Some people are very competent to build small works, and it does not necessarily follow they will be successful in building large works; people who have been successful in large works sometimes fail to act in the most advantageous way in small works, their training is somewhat different.

"In making my report, I have not intended to leave unworked any (4293) promised and reliable source of information. I consulted Hermann Schussler: Mr. Herrmann, who was chief engineer of the company last year; Mr. Elliott, who was engineer of the company this year; Mr. Lawrence, Mr. Sharon and I have talked matters over constantly with Mr. Metcalf and with Mr. Eastman. I have talked with men in the pumping houses, and so on. For the most part, the figures in my valuation are my own. I was not familiar with flume construction, and I went over the data that Mr. Lawrence had with him, and I think he is more responsible for the estimate than I, although I had something to do with putting it in shape. I took Mr. Lawrence's figures directly on the roads, fences, and telephone lines. Mr. Farquharson, a builder, made an estimate of the cost of reproducing the buildings, and ordinarily I used his figures. I did not always follow them exactly, as sometimes I thought I had reason for modifying them.

(4294) "In a broad way, the construction of a water works plant is more expensive on the Pacific Coast than it is in the East, because the freight rates add to the cost of most of the materials, and because the wages paid to laborers are higher on the coast here than on the Atlantic Coast. The climate of California is much more favorable to some kinds of construction, and affects advantageously the cost of those parts of the work. I mean by 'climate', rainfall, temperature and lack of frost. The amount of storage required in the Spring Valley System is similar to that required in other Pacific Coast systems, but it is very much greater relatively than is required in Eastern systems, because in the first place the rain here falls in the winter, and the run-off occurs at the same time, and storage must be provided to maintain practically the whole supply during the long rainless summer. The second reason is that the amount of rainfall differs from year to year a great deal more in California than it does along the Atlantic Coast. Some years it is very much above the average, and in others it is so little that the run-off is comparatively small; storage must be provided to hold the excess flow of wet years, and maintain the supply during the dry years. Taking the two matters together, the amount of storage that must be provided in California is quite a number of times greater than it is in the East."

It occurs to me to suggest in passing, your Honor, that that statement might well be compared with the statement that Mr. Olney has just read of Mr. Dillman's.

(4295) "The sources of supply for San Francisco are rather remote; only a few American cities have gone as far for water. There are quite a number of conspicuous cases where water has been brought farther. The possibility of earthquakes is a factor that is to be considered, and has been considered in the design of the plant; it leads to a number of different arrangements from those that might be selected if it were not for this consideration. The city is a very hilly one, and that means that the system is cut

up into an unusual number of separate services, each one of those for the purpose of distribution is practically independent of the others; the fact that it is necessary to have quite a number of these services at different levels adds to the cost of the service in comparison with like costs for eastern cities where the ground is flatter, and ordinarily most of all the water is supplied at the ordinary low service level."

I ask your Honor to bear in mind, as we proceed with this valuation, this fundamental discussion of Mr. Hazen's.

What Is Basic Cost As Applied to Reproduction Cost?

Basic cost has been assumed in these proceedings to be the cost at which the structures could be reproduced, as of the date of valuation, December 31, 1913, at normal unit prices, prevailing in general during the period under discussion, 1907-1915, built by a well managed public utility corporation either by day labor or under competitive contract when more advantageous.

To this basic cost must then be added an allowance for two other classes of costs, which the owner of the property, whether municipality or corporation, always has to meet, and which cannot well be, and generally are not, included in the basic costs,—

1st. The preliminary and overhead expenses.

2nd. Interest-during-construction expenses.

These two allowances will be discussed after the analysis of the basic costs. Therefore, it is to be borne in mind constantly that the basic costs do not include any allowance for preliminary, overhead, and interest-during-construction costs.

The fundamental conception of the difference between contract and day labor costs was so admirably put by Mr. Hazen that it is quoted below: (8246-8.)

"The question of contract came up. It is my thought that on some kinds of work that enter into the construction of this system, that the Spring Valley Water Company, with its own men, could do the work more advantageously than it could be done

under contract, and that they would do all such parts of the work in that way; that would include the laying of pipes in the city, and I certainly think they would not want a contract there. There are other parts of the system where I think a contractor could do the work cheaper than the company could do it; the contractor could do the work and make a profit, and do it to better advantage to the company than the company could do it by day labor. Just what parts those would be, I have not altogether separated. Wherever I thought the work could be done advantageously by contract, I assumed that it would be done, and I assumed that the contractor would make a profit that would be normal for those parts of the work. In a general way, I think, that would cover the dams, and the outside pipe lines, and perhaps the tunnels.

"Generally speaking, the company building this system, with good average engineers, such as they would be likely to have, would have, in their organization, men normally with experience, and equipment and capacity for building a structure like the Crystal Springs dam, comparable to what a good many contractors have. It is my notion that they could let a contract for that, and that a contractor could do those parts of the work, and make a profit, and do it more advantageously to the company than it could be done by day labor, and take all the risks of bad methods, of accidents, and all that would go with it; in other words, I am assuming that they would use the contract, or the day labor system, whichever was best adapted to each particular part of the work. It seems to me when we get contractor's costs, if we can get them, which we very rarely can, because the contractor is not under any obligation to give us those figures, if he does it, he does it voluntarily, and we are not oftentimes sure as to what it includes, but if we assume that the principal can do the work at the same cost as the contractor—I don't think it is a fair assumption—it is not justified by facts. The contractor can normally do the work cheaper than the principal can do it; otherwise, there would be no object in letting the contract. In connection with

such figures, a profit must be figured. In connection with work that is normally and advantageously done by day labor, by the principal, and it had best be done that way, in that work I have not assumed any contractor's profits."

The method followed by the other witnesses was in substantial accord with that of Mr. Hazen, with the difference, perhaps, that it was assumed by them that on the construction of such large works a very considerable proportion, if not all of the work, would be done by the corporation by day labor, in accordance with general experience in the past upon the Pacific Coast—where the construction of large public works by contract, has not been of such common occurrence as in the central and eastern portions of the United States.

Attention is called to the fact that Lippincott's method of cost determination, which was in accord with his past practice, differed somewhat from that of the other witnesses by the segregation of the plant or auxiliary charges from his basic costs. Therefore, to make comparison of his figures with those of the other witnesses, his auxiliary charges should first be added to his basic costs.

Comparison of Methods of Estimating.

Hazen's method of estimating has already been cited—the use of actual final costs of recent construction by the company, or of similar works built by others under conditions thoroughly known to him; the analysis of past total costs; first, segregated under a few of the most important items, instead of a multiplicity of items which would increase the danger of omissions and tend to undervalue the hazard and contingent elements without increasing the accuracy of the estimate; second, by comparison of final costs always with the same known basic standard, such as was used by him in his discussion of riveted pipe line costs; the citation of comparative data obtained in this locality and at greater distances, but always of work done under conditions with which he

was personally familiar; the elimination of current quotations by manufacturers or supply dealers, and proposals or unit contract prices, as misleading and generally giving part cost only.

Similar methods were used by Herrmann, Lippincott, Wilhelm and James Martin; while Elliott, Lawrence and Sharon presented all available records of original cost incurred by the company.

Defendant's own witness, David Dorward, formerly superintendent of the pipe shop at the Risdon Iron Works, honest and experienced in pipe making, corroborated in a convincing manner Hazen's testimony upon the danger of taking list prices or quotations upon pipe of certain dimensions without specifying just how it was to be made, as was done by Dockweiler.

(4926) "MR. McCUTCHEN: Q. When you get it at low prices what sort of pipe do you ordinarily get?

"MR. DORWARD: A. To begin with you will get the cheapest kind of steel, full of sulphur, that don't last as long; the workmanship will be slighted wherever it can be done, if the establishment making it is not responsible."

* * * * * * * *

(4927) "Q. The fact then, Mr. Dorward, that you got a list price or a quotation on pipe of certain dimensions without specifying just how it was to be made would not be very enlightening in determining the value of that pipe, would it?

"A. It would not, no.

"Q. Would it be accurate to say from your experience that you could get almost any sort of a quotation on pipe?

"A. You can get various quotations; you can get quotations of the very highest class of work and quotations for reasonably good work, which will be somewhat less.

"Q. Can you get quotations of still poorer work?

"A. I don't know any engineer that would accept anything like that."

* * * * * * * *

"Q. Now, is it not possible, Mr. Dorward, that that variation would be anywhere from 25 to 50% between the good product and the indifferent product?

"A. 15% might be close to it. You might get one bid for poor work that would be 15% below good honest work.

"Q. Don't bids vary on work of that kind very much more than 15%?

"A. If you put high-class iron against poor steel there is much more variation.

(4927) "Q. There might be a variation in that case of 25 to 50%, might there not? A. Yes.

Dillman, too, condemned this method: (4688.)

"I got no written quotations on riveted pipe to use for the purpose of making my appraisal. I do not keep track of the market prices. I have not paid very much attention to quotations, as I do not regard them as of very great value."

(7083) "It is very hard to apply the statistics of one piece of work directly to another unless you understand, not only all the usual facts, but also some of the unusual facts."

The witnesses for the defendant cited but few and limited examples of complete final costs of similar work with which they had been personally familiar.

Dockweiler, lacking personal experience, was reduced to the method of synthetic cost estimate, building up his unit prices by the addition of quotations obtained by him from manufacturers and supply dealers, and a heterogeneous collection of cost data assembled by others upon works with which the witness was sometimes familiar and sometimes not, rarely checking the final figures thus obtained, with the actual final costs developed upon similar works. The obvious danger of this proceeding is that in dealing with minutiae there is great danger of omitting some substantial elements of cost, and the hazards, uncertainties and contingent elements are almost certain to be underestimated. These elements do not occur upon every item entering into the work, but are

certain to occur upon many items in any large piece of construction, and the difficulties are greatly enhanced by the length of the period of construction involved, which introduces financial hazards of no mean proportions, owing to the change in cost of labor and materials from year to year, or even month to month, depending upon supply and demand. This was adverted to by Hazen, Metcalf and others in their testimony. The greater detail of the synthetic cost estimate does not imply greater accuracy of result unless controlled by experienced judgment, and tested by other practical standards of cost.

Dillman, with his scorn of past records of cost, was seriously lacking in breadth of experience in the water works field, and his loose methods of estimate to which he was therefore driven often resulted in serious injury to the company.

Summarized Comparison of Gross Reproduction Cost of Structures In Major Groups.

There was prepared and submitted to the court, for its convenience, the following summarized comparison of the gross reproduction cost of structures in major groups, before (i. e. excluding) the addition for overhead and interest-during-construction allowances, of the several witnesses, the estimates being as of date December 31, 1913. There is occasion for me to use tables, your Honor, at considerable length, and I am going to ask Mr. Sharon, as I come to them, to pass them around, so that your Honor and counsel can have them before you when we discuss them.

THE MASTER: And do you want them to be bound into the record at this point?

MR. GREENE: Yes, your Honor, they may go into the argument as we proceed. At this point I refer to Table I.

[Table inserted opposite]

MR. SEARLS: I would like to ask you about another matter. In making these tables up, Mr. Greene, have you taken into account the corrections which Mr. Dillman and Mr. Dockweiler have made?

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Table 1.

Summarized Comparison of Gross Reproduction Cost Estimates of Inventoried Structures Under the MAJOR GROUPS Discussed in Evidence and in Joint Exhibits Submitted, with Summarized Figures Covering Structures not Discussed, Excluding Overhead and Interest-During-Construction Allowances as of December 31, 1913.

SPRING VALLEY WATER COMPANY, San Francisco

Note:—Corrections have been made herein for items duplicated in the lists originally submitted. The partial estimates of other engineers are shown in the detailed sheets only. (**)

STRUCTURES	Allen Hazen	J. H. Dockweiler	Geo. L. Dillman	Joint Exhibits	REMARKS.
(1)	(2)	(3)	(4)	(5)	(6)
1. Wrought Iron Pipe (outside of city)	$3,413,059	$2,511,095	$2,544,179	$	Excluding Wrought Iron Pipe included in Joint Exhibits on Pumping Sta.
2. Earthen Dams and Flumes	1,252,586	781,446	836,056	.....	Excluding Buildings in Joint Exhibits but including flume lumber in place ($183,000. in Joint Exhibit "Buildings and Flume Lumber").
3. Tunnels	1,124,095	833,963	650,183	.....	(Lippincott $1,100,757.)
*4. Buildings	* 152,310	* 147,656	* 151,299	150,000	
5. Pumping Stations (Entire System)	1,162,119	1,039,605	1,120,311	1,092,570	Excluding Buildings, $82,-430. covered in Joint Exhibits of Buildings.
6. Crystal Springs Con. Dam	1,754,176	1,195,493	1,320,760	.....	Excluding Bldgs. in Joint Ex. & Booster Pump Sta. for Lippincott's figures upon part of these structures see detailed analysis hereto attached.
7. Crystal Sprgs. Upper Dam	261,300	184,283	171,143		
8. Sunol Filter Beds	393,072	267,800	234,083	.....	Excl. bldgs. in Joint Ex.
9. Sunol Filter Bed-Bldgs	5,423	5,758	150	.....	" " " " "
10. Niles Aqueduct	93,603	78,585	93,566	.....	" " " " "
11. Submarine Pipes	450,695	321,582	305,674	.....	
12. Roads, Fences, Electric Transmission Lines & Ravenswood Wells	307,674	333,636	252,221	276,000 11,500	Pleasanton Ranch House Fences.
13. Lake Merced	214,834	148,956	173,770	.....	Excluding Tunnels.
14. Lake Merced Supply & Discharge Pipes to Pumps	103,093	96,607	89,586	.....	
15. 30" Conduit from Ocean View to Central Pumps	21,000	28,745	Not Valued	.....	
16. Lake Honda Supply Main	109,442	80,898	89,928	.....	Excluding Tunnels.
17. 30" Central Pumps Force Main	37,731	34,778	36,456	.....	
18. City Reservoirs	865,817	594,273	652,906	.....	
City Distribution Pipe System:					
19. a Screw Pipe	189,913	146,713	142,743	140,000	
b Cast Iron Pipe	4,048,411	3,772,989	4,041,583	4,013,000	
c Wrought Iron P.	502,224	327,299	344,803	.....	
d Existing Pavements	1,391,850	977,893	1,392,531	1,319,000	
e Tunnels	11,966	7,556	6,434	.....	Excluding Bernal Tunnel (Included in "Tunnel Schedules")
f Pipe in Tunnels	24,459	15,269	14,757	.....	
g Trestles	9,098	9,518	8,904	9,000	
h Cast Iron Pipe on Trestles	Included in C. I. Pipe above.				
i Wrought Iron Pipe on Trestles	15,405	9,441	9,183	.....	
j Gate Valves & Bxs. (C. I. P.)	130,276	173,790	160,703	148,000	
k " " " " (W. I. P.)	6,565	7,775	7,650	7,220	
l Stop Cocks and Bxs	2,057	2,197	1,444	2,000	
m Check Valves and Boxes	3,386	1,895	1,712	2,600	
n Air Valves & Boxes (C. I. P.)	Omitted	1,559	1,470	1,400	
o Air Valves & Boxes (W. I. P.)	"	386	406	410	
p Blow-offs (W. I. Pipe)	"	676	1,241	1,070	
q Meters	382,907	314,607	296,033	366,000	
r Services	92,786	110,117	244,521	96,000	
19. Total City Distribution System	$6,811,303	5,879,680	6,676,118	.....	Excluding Bernal Tunnel in "Tunnel Schedule"
20. TOTAL	18,533,332	14,564,839	15,398,389	.....	Included
21. Calaveras Dam	554,113	539,828		.....	(Of these amounts the
22. Structure Values not discussed in Detail in Evidence	408,665	344,878	474,192	.....	Pleasanton Ranch Houses cover respectively $170,141; $129,121; $198,792.
23. TOTAL	19,496,110	15,449,545	15,872,581	.....	Note that Dockweiler erroneously omitted to value the hop ranch bldgs.
24. (X) Add to Hazen (San Mateo Screen House)	+ 984	.....	.....	.....	Included in Dillman's
25. (XX) Add to Hazen (Belmont Pumps)	+4,600	.....	.....	.....	Grand Total.
26. Add to Dillman (Pilarcitos U. D.)	.....	.....	+20,000	.....	
27. Add to Dillman (San Andreas P. L.)	.....	.....	+ 100	.....	Error in addition in Dillman's Inventory.
28. Add to Dillman (Sunol Filter Bed Bldg.)	.....	.....	+ 200	.....	Erroneously omitted from Bldg. Schedule.
29. Deduct from, Dillman (Stone D. Aq.)	.....	.....	− 175	.....	
	$19,501,694	$15,449,545	$15,892,706		(Included in Bldg. Schedule owing to error in Structure numbers, structure 45 being omitted in Dillman's inventory.)
30. Deduct from, Dillman (Alameda P.L.)	.....	.....	− 194	(†) (See note below)	
31. Grand Totals (excluding Overhead and Interest - during - Construction and Stock on hand	19,501,694	15,449,545	15,892,512	.....	Excludes, Stock on Hand Hazen, $401,350; Dockweiler $341,740. Excluded by Dillman; respectively agreed to at $401,350.

**Corrections admitted by Dockweiler made herein as per attached schedules. Note also his failure to value hop ranch bldgs. Correction for error of $95. made in figures submitted herein as Dillman's.

Note.: Agreed allowance for stock on hand less depreciation $289,940.

(*) Dockweiler's and Dillman's figures for "Buildings" ($147,656 and $151,299) are too high by $1,114 and $1,761 respectively, when compared with the "Building" Schedule totals, the reason being that where one did not appraise the buildings separately, the other's figure was assumed to apply for comparison purposes only, but was not added in the total.

(X) This amount $984 is the error in the "Building" Schedule, caused by not including it as "Buildings." Amounts for corresponding items for Dockweiler and Dillman were included in the "Building" Schedule.

(XX) Amount of $4,600, due to revision of Belmont Pump appraisal after the "Pump" Schedule was completed.

†Dillman allows $25 for Structure 30. Dockweiler's figure of $219 was assumed to apply for "Building" and was included at that amount ($219). Hence, Dillman's total is too high by $219 − $25 = $194.

MR. GREENE: Yes, Mr. Searls, I think we have in every instance where we have been advised of any corrections. I think the table speaks for itself. I had it prepared in order that we might have a basis of comparison as we took up the different items. Your Honor will observe that on line 23 the total reproduction cost of structures, exclusive of overhead, interest during construction, and without any deduction for depreciation, is shown for Messrs. Hazen, Dockweiler and Dillman. There are certain notes at the bottom of the table, some of which refer to the corrections just discussed by Mr. Searls, and others of which explain figures that were the subject of discussion while the evidence was being introduced. I think it is proper to say at this time to counsel on the other side that of course we shall be glad to have any errors in any of these tables called to our attention, for correction; also, in cases in the argument when I use the abstract,—and although it is not very often, it is done more often than to warrant the use of the word "occasionally,"—if counsel on the other side sees any inaccuracy or unfairness in the abstract, I should be very glad to have that correction made when the argument is printed.

MR. SEARLS: I noticed one instance the other day, in Mr. O'Shaughnessy's testimony, where I thought it conveyed a little different impression.

THE MASTER: At some point in your argument you will cover the witnesses who do not appear on this sheet, I suppose?

MR. GREENE: Most certainly, your Honor. This, I think, can be fairly termed the base table, and the others will be supplementary to it.

In addition to the comparative figures shown in this table submitted by Hazen for the plaintiff, Dockweiler and Dillman for the defendant, and the joint exhibits, testimony was given upon the reproduction cost of various classes of structures by other witnesses.

The testimony upon the reproduction cost of these structures will now be discussed in the major groups, followed in the introduction of evidence, to-wit:

1. Riveted pipe outside of city.
2a. Earthen dams.
2b. Flumes.
3. Tunnels.
4. Buildings.
5. Pumping stations (entire system).
6. Crystal Springs concrete dam.
7. Crystal Springs upper dam (earthen).
8. Sunol filter beds.
9. Sunol filter bed buildings.
10. Niles aqueduct.
11. Submarine pipes.
12. Roads, fences, electric transmission lines and Ravenswood wells.
13. Lake Merced drainage system.
14. Lake Merced supply and discharge pipes to pumps.
15. 30″ conduit from Ocean View to Central pumps.
16. Lake Honda supply main.
17. 30″ Central pumps force main.
18. City reservoirs.
19. City distribution pipe system.
20. Calaveras dam.
21. Structure values not discussed in detail in evidence.

It of course goes without saying that as to some of these items there will be practically no discussion whatever, but it seemed advisable, for the purpose of completeness, to have a reference to all the subjects, so that as the discussion progresses we will have all the items of substantial value referred to in the argument itself.

Table 2

COMPARISON OF BASIC COST ESTIMATES UPON RIVETED PIPE LINES OUTSIDE OF CITY, AS OF DEC. 31, 1913.

(Abstracted from Major Group Analysis which was based upon individual Inventoried values.)

Pg.		Structs.	Hazen				Dockweiler				Dillman			
			Pipe	Excav.	Miscl.	Total	Pipe	Excav.	Miscl.	Total	Pipe	Excav.	Miscl.	Total
			$	$	$	$	$	$	$	$	$	$	$	$
4	25	Pilarcitos Aque...	7,050	.....	1,100	8,150	5,292	767	1,031	7,090	6,451	Incl.	in Pipe	6,451
5	27	" Aqe. Siphon	3,800	.....	200	4,000	2,485	471	252	3,208	2,723	"	" "	2,723
5	29	" " "	13,300	.....	500	13,800	9,371	985	340	10,696	8,688	"	" "	8,688
5	31	" " "	6,700	.....	250	6,950	4,371	494	4,930	9,795	4,325	.....	5,852	10,177
9	26	Stone D.Aqueduct	20,800	.....	.....	20,800	10,861	2,550	484	13,895	19,253	Incl.	in Pipe	19,253
21	11	San Andreas Ser. Tank.....	353,228	.....	28,953	382,181	235,952	28,313	16,795	281,060	255,919	19,939	17,387	293,245
22	15	San Andreas	207,064	.....	3,126	210,190	112,292	19,617	6,103	138,012	129,415	.....	5,624	135,039
23	20	Conduit to O. V. Pumps.....	178,536	.....	9,680	188,216	81,064	14,448	11,184	106,696	123,602	.....	14,016	137,618
24	25	San Andreas, Old Forc-Main.....	12,886	.....	689	13,575	.....	.....	.....	.....	10,340	Included	in Pipe	10,340
33	1	Cry. Spgs. P.Line	414,329	.....	31,179	445,508	259,354	39,535	22,825	321,714	328,745	.....	13,754	342,499
34	4	" " Mill to Univ. Md.....	469,886	.....	32,376	502,262	300,152	42,456	51,531	394,139	348,418	30,326	34,812	413,556
80	8	Niles Aqueduct...	48,255	.....	1,076	49,331	26,933	3,741	3,467	34,141	30,580	.....	1,845	32,425
91	25	Pleasanton Well System & Sunol Line.....	84,722	.....	3,230	87,952	77,268	23,802	6,538	107,608	87,680	.....	6,096	93,776
129	4	Alameda P. Line	446,648	.....	72,379	519,027	275,556	29,035	83,379	387,970	259,862	20,199	79,783	359,844
136	24	" " "	404,513	.....	9,721	414,234	243,791	37,277	19,656	300,724	229,742	27,410	13,432	270,584
138	34	" " "	526,565	.....	20,318	546,883	326,943	50,763	19,546	397,252	400,761	.....	14,300	415,061
		TOTALS.....	$3,198,282	.....	$ 214,777	$3,413,059	$1,971,685	$ 294,254	$ 248,061	$2,514,000	$2,218,302	$ 97,874 (Incomplete but incl. in pipe.)	$ 206,901	$2,551,279

SUMMARY OF ESTIMATES ON RIVETED PIPE OUTSIDE OF CITY

	Allen Hazen	J. H. Dockweiler	G. L. Dillman
Riveted Pipe, furnished and laid	$3,198,282	$1,971,685	$2,246,504
Excavation.....	.....	294,254	97,874
Miscellaneous.....	214,777	248,061	206,901
TOTALS.....	$3,413,059	$2,514,000	$2,551,279

Hazen's segregation of Miscellaneous is somewhat different from the others, as he includes some of their items in the pipe costs. Dillman's segregation of items is incomplete, the total excavation corresponding to his four items is 199,006 cu yds.

1. Riveted Pipe Outside of City.

I shall first take up, in accordance with this schedule, the riveted pipe outside of the city.

On that subject the plaintiff's witnesses were Elliott, Hazen, Lawrence, Metcalf and Sharon; the defendants' witnesses were Dillman, Dockweiler, Dorward, Ellis, Moebus, Rhodes and Stocker.

Condensed Summary of Estimates:

Owing to the different methods of estimating the reproduction cost of riveted pipe lines, adopted by the several witnesses, it is practically impossible to make a just comparison of the detailed cost of the items entering into each of the unit structures.

The safest and most equitable bases for comparison are the cost-per-pound of metal,—covering the more important steps in the furnishing, manufacture, and laying of the finished riveted pipe lines,—the unit weights-per-foot of pipe of different diameters, and the final total estimate of each of the witnesses.

In the following table is given, however, such "Comparison of Basic Cost Estimates upon Riveted Pipe Lines Outside of City, as of December 31, 1913, Abstracted from Major Group Analysis, which was based upon Individual Inventoried Values" as could most readily be made from the detailed reproduction cost estimates of Hazen (Pl. Exh. 96), Dockweiler (Def. Exh. 121), and Dillman (Def. Exh. 101).

[Table inserted opposite]

From this comparison it will be seen that Hazen's estimated reproduction cost of the riveted pipe outside of the city, furnished and laid, excluding overhead and interest-during-construction allowances,—according to the Major Group Schedule discussed in evidence,—amounted to the sum of $3,413,059; Dockweiler's to $2,514,000 and Dillman's to $2,551,279,—the difference between Hazen's estimate and those of the defendant engineers being respectively, $901,964 and $868,880.

I think the table is clear and speaks for itself.

Inasmuch as Hazen included excavation and a portion of the miscellaneous expenses in his pipe costs, and Dillman the excavation in many cases and the miscellaneous expenses in some cases in his pipe costs, no detailed comparison can be made of the total excavation and miscellaneous expense items in this tabulation. The table will be found useful, however, for purposes of checking certain of the units involved as will appear hereafter.

Further testimony upon certain elements of cost was given by other witnesses,—the most important of these being Dorward, whose evidence will be discussed in detail. None of the other witnesses gave complete estimates covering this group of structures.

Necessary Basis for Comparison in Detail:

In view of the facts stated, and of the relative experience of the several witnesses who testified upon riveted pipe costs, it will be found most advantageous to analyze Hazen's estimate, and thereafter to compare the estimate of other witnesses with Hazen's as a standard of comparison, determining the more important causes for the differences in estimates,— the estimates of the defendants' witnesses being but approximately three-quarters of Hazen's.

It will be shown that differences in assumption as to quality of material, weight of pipe in pounds per foot, and the cost of metal, fabrication, excavation and backfilling are the controlling causes for the wide range in estimated reproduction cost of the riveted pipe lines outside of the city.

Hazen bases his estimate upon three lines of evidence,—first, actual cost to the Spring Valley Water Company; second, reproduction cost, determined by the methods ordinarily used by him in his pipe line construction work, the outgrowth of large past experience and based upon accumulated data available in his office; third, actual comparative costs of riveted pipe lines built elsewhere in the United States by other water works. Hazen's unit costs were segregated by him broadly under the heads of

cost of the metal, fabrication, excavation and accessory and miscellaneous items.

Elliott's testimony was limited to actual recent construction costs of riveted pipe lines laid in the city. Unfortunately, these were few in number, small in amount, and built under conditions so different from those of the main riveted pipe conduits as to make them incomparable (directly) and of limited significance.

Lawrence's testimony, for the plaintiff, was limited to his knowledge of such portion of the construction cost of the original pipe lines as was to be found in the records of his department, which costs he gave and also brought down to date, as to the labor items, by the change in hours of employment and rate of wages.

Dockweiler, for the defendant, having had substantially no personal experience in riveted pipe work, made a synthetic estimate based largely upon arbitrary assumptions, and in less degree upon partial cost analyses of a few other pieces of work which were, in the main, incomparable with the Spring Valley work. His estimates of cost of the plate and of excavation, only, are entitled to weight, because of the method of their determination; his estimate of the cost of fabrication is without significance, because of his lack of experience and ignorance upon this subject.

Dillman's estimate for the defendant, is of no comparative weight by reason of his admitted inexperience and his scorn of the records of others in this field of engineering work.

Moebus' evidence for the defendant, was of little significance, being of the most general nature, without supporting data, and limited substantially to the cost of fabrication and profit allowance. He manufactured the Pleasanton pipe, which is acknowledged to be the poorest pipe in the system. (4601-7)

C. I. Rhodes' evidence for the defendant was based solely upon such partial records of cost as he was able to observe in the factory of W. W. Montague & Company in San Francisco, while he was inspecting the construction by them of a riveted steel pipe line for the Monterey Water Company. His cost records

were valueless, because based upon observations of individual steps in the process of manufacture, during isolated, disconnected and brief periods of time, such as hours and days, and not upon the entire time and total cost involved in the construction of the work, as evidenced by the books of the company, or the complete records. This was clearly brought out by Hazen (4761-4).

Stocker's evidence, for the defendant, was limited to some costs of the cast iron pipe high service fire protection system built by the city of San Francisco, and some of the basic computations of cost for Dockweiler's reproduction estimate.

The principal witness for the defendant, and the only one whose evidence upon the cost of riveted pipe was of real significance, was David Dorward, foreman and subsequently superintendent, of the shop of the Risdon Iron Works of San Francisco. His estimate was based primarily upon his old cost notes, made while foreman in the shop of the Risdon Iron Works which built several of the Spring Valley pipe lines, and upon his years of past experience in this field; but unfortunately, owing to the fact that he had not had access at that time to the books of the company, or at all events that his notes were not based upon the final cost of the different jobs, as revealed by the books of the company, and that the books themselves had been destroyed by fire, his estimate of proper "profit allowance," and in lesser degree "shop overhead," was not as conclusive as it might otherwise have been. Dorward did not submit an estimate covering all of the riveted pipes, but fortunately his estimate covered a major portion of the work, sufficient in scope and amount to make possible a rigid analysis and determination of the fairness of Hazen's estimate. Dorward's evidence is entitled to consideration, and will doubtless be found of great assistance to the court.

THE MASTER: Did he cover excavation?

MR. GREENE: No.

Effect of Quality Upon Price:

Hazen stated that "There are as many kinds of iron as there are kinds of wine; there does not seem to be any limit to the variation in the process of manufacture." (4314); and gave a most interesting description of the difference between charcoal iron, puddled wrought iron and steel and the process of manufacturing each, and traced the gradual substitution of steel for iron, the causes that led up to it and the practical effect of the substitution. (4316-21)

He called attention to the difference between buying pipe "by weight" and "by gage", and showed that when pipe is bought to the minimum gage thickness at the edge of the plate, which is what is meant by buying pipe "to gage", the weight is from 8 to 10% greater, for any specified thickness, than when the plate is bought by the weight corresponding to the average thickness. (4307-8) He stated that a great deal of the riveted pipe on the Pacific Coast is bought by weight, as it was for instance at Los Angeles and as some of it was bought in San Francisco. (4527-8).

"The cost of fabricating pipe," he says, "depends upon how it is done. If pipe is made under an adequate plan and specification and with adequate supervision, it will cost a great deal more than if it is done in a less perfect way that the manufacturer may very likely use, if he is not working under such specification and inspection; and I should give no weight whatever to a simple quotation from a manufacturer that was not tied up in some way." (4569.)

He then calls attention in a pointed way to the fact that low bids are often to be accounted for by poor quality of material and workmanship. "Some very low prices for manufactured pipe in California have been quoted. These prices relate mostly to the period of depression of the last year or two, and do not represent normal conditions for the purpose of estimate. * * * * * In some cases they represent inferior metal and inferior workmanship. For example, in some cases the pipes are greatly under-

riveted and the caulking of the seams has been imperfectly done, or omitted altogether. For these reasons, records of such sales at low prices, where the conditions are not comparable to those of the Spring Valley Water Company pipes, have been disregarded. That may be a very important matter, and perhaps I had better say a little about it at this stage. In the first place, as to inferior metal, I have learned by inquiry that metal frequently comes to shops on the Pacific Coast and is made up without inspection. There is a great difference in the quality of steel. When steel is drawn from a furnace, it is first cast into an ingot. (4348) * * * * The top of the ingot that cools last, and where these impurities collect and where there are apt to be openings, is called the pipe; that pipe extends quite a long distance down in the ingot; it is customary to cut the ingot into five pieces, for the purpose of rolling into plates. If one wants a good grade of metal, it is customary to exclude for pipe making the top fifth of the ingot, and if the pipe shows after the top fifth is cut off, then you exclude the second fifth. * * * * * We are in the habit of paying an additional price for metal from the bottom of the ingot for the sake of having this separation made and excluded; we think it is worth while to do that. * * * * * If one is willing to buy steel without inspection, inferior metal from the top of the ingot can be got at cut rates through dealers. It is obviously possible to make up pipe from that kind of metal and to make it at prices that ought not be applied to a discussion of good, first-class pipe." (4349).

He then refers in detail to the different methods of caulking, by splitting the edge of the plates in the cheaper practice, and by bevelling the edge of the plates and caulking both the inside and outside of the seam, in the best practice. (4350).

"It is further to be noted that prices per pound for pipes made from thick plates are not applicable to pipes made from thin plates. The cost per pound increases as the plates are thinner." (4351).

He calls attention to the marked difference in the character and cost of pipe coatings, and finally comments upon the desirability of rigid specifications and inspection of the materials and labor entering into the construction of the pipe. (4571-3)

Hazen examined the pipes in the yard of the company and at such points as openings could be made, actually crawled through long sections of the pipe line, and concluded that "It is perfectly clear, however, that the old iron in this system was of magnificent quality. That is shown by the records of the pipe in service. This old Scotch iron, much of it, one-tenth of an inch thick * * * averaging 45 years old has stood wonderfully, and the recent pipes, all of the pipes were in splendid condition. I have never seen old pipes in any water works system right through in as good order, as free from rust and corrosion as the riveted pipes of the Spring Valley system." (4314) "These pipes are extraordinarily free from that corrosion and tuberculation." (4315)

Not content with the local evidence which he found concerning the character of the material which went into the Spring Valley pipe lines, he corresponded with David B. Oliver, the manufacturer of the metal of which several of these pipe lines were built, who looked up his old records and was able to give him specific information concerning their experience in building these pipes. "The specifications for these plates showed that they were to be of a high quality, and we soon found that our usual method of making iron plates would not meet the requirements, and we had a great deal of trouble and expense before we succeeded. The plates had to be perfect on the surface, and the inspection was so severe as to make them, so far as appearances were concerned, the equal of boiler plate."

"We finally succeeded in meeting the requirements by the use of hammered iron slabs for tops and bottoms from the piles from which the plates were made, and even with the use of tops and bottoms, we found it necessary to give the piles what in mill parlance is called 'wash heat', all this adding to the expense,

but it enabled us to fill the order to their satisfaction. Then, again, in shipping the plates, great care had to be taken to protect them from dampness in transit, as we understood from one of our men whom we sent out to California, that the German engineer in charge of the work had a peculiar paint, which required a perfect, smooth, sound, metallic surface to be effective, and that he was unrelenting in requiring the specifications to be filled in every respect."

"The plates, as we understood, were to be used for a water line, and I think the pipe was to be about 36 inches in diameter, and of varying thickness, owing to the fact that it climbed hills and went into valleys, and a varying pressure had to be provided for."

"I was told at the time that two large plate manufacturers, one in the East, and one in Pittsburg, had undertaken the order, but owing to the strict requirements, had given it up, but we got through with it, and I think we succeeded in turning out a lot of material which we could stand by." (Signed) David B. Oliver (4808-9).

As a result of all these inquiries Hazen was able to give the admirable and convincing statement concerning the amount and character of the material of different kinds—charcoal iron, puddled wrought iron and steel—which was actually used in the construction of the riveted pipe lines by the Spring Valley Water Company. (Pl. Exh. 98b, e, f, j) (4326-30).

Hazen commented at various points upon the unreliability of quotations by manufacturers (4576); upon the very inferior, underriveted, not caulked and not properly trimmed character of two of the shorter steel pipe lines built for the company by the Western Pipe & Steel Company—and, by the way, one of those lines was the Pleasanton line, which, as I recall it, was valued by Dockweiler higher than the pipe line Mr. Hazen has just referred to and which is mentioned in the correspondence of Mr. Oliver; and upon the incomparable character of the steel siphons of the

Los Angeles aqueduct, which were built at a time when work was scarce and prices were low, and at prices which showed the manufacturers no profit, upon specifications for steel which were not exact and which would have permitted the delivery by the contractors of a grade of steel which would not have been accepted on any of the works with which he had had to do; the inferior coating which was applied by painting and not by dipping; the work done upon large pipe, 11, 12 and 13 feet in diameter in an entirely different way and under different conditions from the Spring Valley pipes and built of much thicker plates (4555-6); the special character of the cost accounting used in Los Angeles, which makes difficult the determination of the portion of the indirect costs which should be included in the basic cost of these pipes, to make the prices strictly comparable with other prices upon steel pipe lines (4558); concluding his observation upon the portions of the Los Angeles aqueduct built of steel pipe by the significant comment that, "I recognize that Mr. Mulholland is a marvelous organizer; he put this work through in a wonderfully creditable way, and very cheaply, and deserves all the credit he has got and will get for it. It is a wonderful piece of work, but I do not think it can be taken as a measure of the Spring Valley system." (4562)

A mere perusal of Hazen's analysis of the riveted pipe lines of the Spring Valley Water Company must convince any fair minded man of the conscientious care with which Hazen made his investigation, in his effort to determine the exact character of the material of which the riveted pipes in this system had been made, in order that he might make a fair valuation of these particular structures and not an academic valuation of riveted pipe lines of arbitrary character, bearing perhaps, no relation to the existing plant, as did some of the witnesses for the defendant.

(4375; Hazen) "My first experience with riveted pipe was about 1897, when I designed about 8200 feet of 48 inch pipe as

part of the Albany-New York Waterworks System." (4376) "I have made estimates for riveted pipe repeatedly in connection with various waterworks projects, and built quite a number of them. Among the more important ones, the riveted pipes at Washington, and about 12 miles of pipe at Springfield, Mass., as part of the new system. I also designed a line of 48" pipe 16 miles from Portland, Me. * * * I have seen many of the principal pipe lines in this country, and have been familiar with the methods that have been employed, and also to some extent with foreign work, and have followed the matter very closely from the first up to the present time. I made estimates for Winnipeg, but was not connected with the construction. I also made estimates for Ottawa, and was responsible for one line of pipe that was laid in Ottawa a few years ago."

Dorward also gave significant testimony concerning the great variety and quality of metal and workmanship in such pipe lines, and the splendid character of those built by the Risdon Iron Works, of which he was formerly shop foreman and then superintendent.

He called attention particularly to the facts that in speaking "of the pipe made nowadays you have got to consider where it is made, because if you pay a cheap price for it, you will get poor work" (4926), and that when you get extremely low prices you are likely to "get the cheapest kind of steel, full of sulphur, that don't last as long; [and that] the workmanship will be slighted wherever it can be done, if the establishment making it is not responsible (4926); [that] there are always concerns ready to take the order at figures below first-class prices" (4927); and that when you get a list price or a quotation on pipe of certain dimensions, without specifying just how it is to be made, it would not be very enlightening in determining the value of the pipe; that there would surely be variation, and if you put high-class iron against poor steel "there might be a variation of 25 to 50%." (4927)

Dorward, too, clearly recognized the difference between buying pipe "by weight" and "by gage", saying that "that means when you take the plate per square foot, the theoretical weight is so much, so many pounds, but if you take the plate according to what they call "gage", that is where the thickness must be maintained at the edge of the sheet, it is swelled in the middle and runs higher." (4908).

In commenting upon the character of the riveted pipe made for the Spring Valley by the Risdon Iron Works, under his direction, he says that it was well made, that he does not know of any pipe being better made than it was, and that it could not be better made (4923); that pneumatic caulking and hydraulic riveting methods, in accordance with the best practice of the day, were used in its manufacture (4924); and that these pipe lines were extraordinarily good "undoubtedly, no question about it * * * first-class work for a good price." (4925)

Dockweiler's absolute lack of experience with riveted pipe and his method of obtaining information concerning its cost alike bar his testimony from serious consideration. (4219)

"MR. McCUTCHEN: Q. Aside from the iron pipe which is in this system [about 1 mile of 12-inch in Westlake Park, Los Angeles], have you ever had anything to do with the purchase, laying or examination of steel pipe?

"MR. DOCKWEILER: A. Nothing other than in the instances I cited you relative to that pipe which I had laid in the City of Los Angeles [400 feet of 24 inch or 30 inch sewer pipe under the bed of the Los Angeles River. 4216].

"Q. That was cast iron pipe? A. No, the plate-iron or sheet-steel, or whatever they call it.

(4225) "MR. McCUTCHEN: Q. You never made any pipe, did you, that is from the plate?

"MR. DOCKWEILER: A. I have been in the factory and seen it made."

* * * * * * * *

"Q. And you never prepared any specifications for the making of any?

"A. Yes, sir.

"Q. Where? A. In the Los Angeles case. [400 feet of 24-inch or 30-inch sewer pipe.]

"Q. There never was constructed under your supervision or direction any element of a water works plant, was there?

"A. Other than the items I instance, I don't think so."

* * *

(4219) "The ability to value a plant of this nature required more or less knowledge of iron pipe. Aside from the iron pipe which is in this system, I have not had to do with the purchase, laying, or the examination of steel pipe other than in the instances I cited to you relative to that pipe which I had laid in the city of Los Angeles."

* * *

(4443) "Referring to the question of fabrication, I have corresponded with pipe men around the bay and in Los Angeles."

* * *

(4598) "I cannot exactly recall what I would say with reference to an inspection, but I would insert clauses sufficient to produce for me a pipe such as I had in mind."

* * *

(4607) "I do not recall that I ever figured on the riveting of any of the Spring Valley lines as to strength as compared with the strength of the plate. Whether it was under-riveted or over-riveted, I took the rivet spacings as they are, so I did not need to worry about that at all, as the pipes have been holding."

* * *

(4635) "I went down to the Risdon Iron Works and saw the operations performed on the pipe, and although they did not tell me what the labor costs were, they did not need to tell me, as I saw what the men were doing. When I looked at these operations I could tell these labor costs per pound of metal."

* * *

(4636) "I got the cost of caulking and cleaning the pipes with wire brushes."

I want to say here, your Honor, I do not believe there is a better place in this case to show the qualifications and experience of Dockweiler than this very examination from which I shall now read. It so happens that we wanted to know the qualifications of Dockweiler before Mr. Hazen went into this matter, and we asked him the questions about the fabrication of pipe for that reason. I quote from that testimony now:

(4218) "MR. DOCKWEILER: A. Sheet-iron and sheet-steel are practically synonymous terms as we ordinarily use them."

* * *

(4219) "MR. McCUTCHEN: Q. That was cast-iron pipe?

"MR. DOCKWEILER: A. No, the plate-iron or sheet-steel or whatever they call it."

* * *

(4220) "MR. McCUTCHEN: Q. How is iron pipe manufactured?

"MR. DOCKWEILER: A. You mean the plate— —, cast-iron or plate-iron?

"Q. Plate-iron. A. The ordinary iron is taken and rolled into strips of the required thickness and size and is turned out in what you call the commercial plate-steel.

"Q. You say the ordinary iron is taken; through what treatment does it pass up to the time it is taken to be rolled into plates?

"A. There comes a time when I don't believe the highest trained specialist can detect the difference between iron and steel; steel is a purified form more or less, or the iron is a purified form, or vice versa, and the handling of it, say the ordinary pig iron as it comes out of the furnace you may say could be put into a heated device and you get out a ball of what they call puddled iron; you can put that into a press or a set of rollers and get out what is known as an iron plate.

"Q. Is all iron plate puddled?

"A. No, the ordinary wrought iron of commerce is a puddled iron."

* * * * * * *

(4221) "MR. DOCKWEILER: A. Whilst I have never seen iron actually handled in a rolling mill I have from general reading gotten an idea how it is treated."

* * * * * * *

"MR. McCUTCHEN: Q. Is charcoal iron and puddled iron the same thing?

"MR. DOCKWEILER: A. I am not sufficiently posted to determine as to that, but I know that you can get what is known as the charcoal iron that is puddled.

"Q. You can get a charcoal iron that is puddled?

"A. That is my impression.

"Q. Can you get a puddled iron that is charcoaled?

"A. I am not up on the technique of manufactured iron. From my general reading of the subject I should determine that. But, Mr. McCutchen, as an engineer it would not be necessary for me to know the actual technique of the fabrication, I could adopt the standard specifications which have produced certain results in other pieces of work and accept that."

* * * * * * *

"A. Some firms make pipe of what they call pure iron, but there are not many. Most of the plate work is steel; most of the large pipe lines are steel nowadays. There is very little iron plate utilized."

* * * * * * *

(4222) "Q. You never have bought any iron pipe, have you, any wrought iron pipe at any time? A. No; only such purchases as I bought—no; I have made some purchases of a few hundred feet, say a thousand feet or so, but other than that, none.

"Q. I suppose that was pipe of small dimensions, wasn't it?

"A. Oh, two or three inch pipe, Mr. McCutchen."

A reading of this cross-examination brings vividly to mind some of Alice's adventures in wonderland.

Dockweiler's basic information concerning pipe prices was obtained from Lacy Bros. Manufacturing Co. of Los Angeles, and the Western Pipe & Steel Co. of San Francisco, upon a brief written request of the most general nature without specifications, but after a short conference, in the course of which no technical information was given other than to specify, very roughly, the approximate head under which the pipe would operate; the significant information was however given to the manufacturer that the figures were wanted for use in the valuation of the property of the Spring Valley Water Company.

A reading of Dockweiler's testimony and of his cross-examination on the subject of riveted pipe manufacture (4590-4686) is all that is necessary to convince one of the flimsy and unreliable character of his figures, particularly as to the cost of fabricating the pipe. His estimate of the cost of the material itself chanced to be fair, probably because of the weight which he gave to the actual cost of this pipe to the Spring Valley Water Company in by-gone years.

Dockweiler's rambling discussion is too lengthy to quote, but a few references follow which indicate its general character.

(4443) "MR. DOCKWEILER: This is to the Lacy Brothers Manufacturing Company:

"'I am enclosing you a list of pipes on which I desire you to give an estimate. The figures I desire assume the fabrication of the pipe in the region of San Francisco Bay, with delivery f. o. b. San Francisco during a period of two years previous to January 1, 1914; that is to say that you were manufacturing the pipe during the years 1912 and 1913. You can readily see that a job of this size would demand in the interests of economy and efficiency fabrication of the pipe in the vicinity of the bay region.'"

* * * * * * *

"MR. DOCKWEILER: He returned to me the list filled out giving his weight per foot and this weight that he gives is for pipe dipped as he says in a subsequent communication, and these prices are for steel to which he said there should be added 20% for Allan Wood iron."

In this connection Hazen's statement concerning the commercial interpretation of Allan Wood iron is to be remembered:

(4721) "MR. HAZEN: I think it ought to be understood that nine-tenths of the Allan Wood Iron & Steel Companies are making steel plates and that steel plates made by the Allan Wood Company are ordinarily sold in the trade as Allan Wood plates. A reference to Allan Wood plates does not mean anything without a very specific description of the quality."

In answer to Mr. McCutchen's question, "If you were preparing specifications for the fabricating of a pipe line of the size of the largest lines used by the Spring Valley Company, what would you provide for?" Dockweiler said: "I would provide first, for the metal as it is in the pipes, using the specifications that were employed, and I would expect to get a plate fabricated equal in quality with that that the Spring Valley used"; yet he did not in fact make use of any specifications in calling for quotations from the two concerns with which he was familiar and from whom he obtained bids. (4591).

(4612) "MR. McCUTCHEN: Q. Well, now, you wrote to Lacy Brothers?

"MR. DOCKWEILER: A. Yes."

* * * * * * * *

"Q. You did not tell them anything about specifications, did you?

"A. No, but I had a private conversation with them before I had, and I told them, 'Now, boys I want to get the reproduction cost of the Spring Valley pipes.'

"Q. Exactly. You told them the purpose for which you wanted that exhibit, did you? A. Yes."

* * *

(4615) "MR. DOCKWEILER: A. Yes, I know Mr. Lacy very well; we have been friends many years."

* * *

(4616) "MR. McCUTCHEN: Q. When you visited the Western Pipe & Steel Co. did you also advise the man to whom you put the inquiry for information that you were making this valuation of the Spring Valley system for the city?

"MR. DOCKWEILER: A. Yes, he knew that I was.

"Q. You did not give him any specifications, did you?

"A. No, I think not other than the heads.

"Q. Are you sure that you told him anything about the heads under which the pipes were to be used?

"A. My impression is that I did. Anyhow he had, I am satisfied he had information on that subject.

"Q. How are you satisfied he got it? A. Now, I do not exactly recall, but he is an engineer, knows the pipe technique very well."

But Dockweiler subsequently admits that he gave no information or specifications as to the necessity for bevelling the edge of the pipe, the character of the caulking, riveting and the quality of the pipe or of the coating. He got no prices from the eastern factories, because, as he says, he was unknown to them and he made no significant comparison with other riveted iron or steel lines, except a few limited comparisons of partial cost figures covering limited portions of incomparable work, more particularly those derived from Los Angeles, concerning which Mr. Hazen's characterization already quoted is to be borne in mind.

Dockweiler's lack of information is further indicated in the following excerpts from his testimony on the cost of fabricating riveted pipe:

(4631) "MR. McCUTCHEN: Q. That is to say, you went to Mr. Brown and Mr. Jones and Mr. Smith engaged in the business of making pipe and they told you what the labor cost was?

"MR. DOCKWEILER: A. Yes. Then another thing, I went down in the Francis Smith shop; this was several years ago; and I ascertained the cost of some steps in the making of pipe.

"Q. One moment, right there: do you mean to say that Mr. Francis Smith told you what his costs were in his shop? A. No, but he gave his foreman permission to tell me, because I was employed by Mr. Francis Smith at that time on some work for him in the Watsonville Water, Light & Power Company; and I told Mr. Smith, 'I would like, if it is not contrary to your principles, to get some shop costs to enable me to figure definitely on certain lines of operation'; so he said, 'Why, yes, you can have them, I don't want you to use them against me', and I said 'all right' and I went ahead"

Similar questions showing Dockweiler's inexperience in riveted pipe work might be multiplied ad libitum, but enough has been shown to characterize his testimony as unreliable.

Dillman's investigation of and estimate upon the riveted pipe lines was of the most general and cursory nature. He made no detailed examination of the pipe beyond looking at some of the pipe in the yard, and seeing a few pipes which had been removed; he made no tests of the pipes himself or through others; he made no examination to determine the character of the metal and contented himself with estimating its cost on a basis slightly in excess of the cost of steel. He made no study of the weight of the pipe, basing his estimate upon some diagram, of a most approximate nature, which he had used theretofore in his office practice for purposes of preliminary estimate. Moreover, his personal experience with riveted pipe construction was very small being essentially limited to the following:

I think I have referred to those instances before but I want to repeat them here because they seem to me of the greatest importance in connection with Dillman's figures:

(4262) "I made plans for the laying of the Hanna & Dana Pipe Line. * * * I think it was about 20 miles long, and a

(4263) part of the reconstructed Union Pacific now. The Hanna & Dana pipes were about a 10 inch line. I did not put the pipe in."

(4256) "I was engineer for the Contra Costa Water Company for a year or so, during which time I constructed two pumping plants, wells and pipe lines."

(4265) "The year I was engineer for the Contra Costa Water Company, which I think was in 1899, I built the Glue Factory plant, and I put in a pump on Cemetery Creek in Oakland. I (4266) was not the general engineer of the company, but was employed for this special work. Orestes Pierce did most of the work."

(4271-72) "I laid a complete system of pipes at Oakdale. I laid pipes from the Glue Factory to San Leandro for the Contra Costa Co., which I think was 18 or possibly 20-inch pipe." * * *

"I do not think I have been in direct responsible charge of the laying of much other pipe, and I do not think I have dug through a pavement to lay pipe. I have laid pipe in a street with other pipes at Oakdale. Some of the other pipes were in use, and some of them were abandoned. They were old water pipes."

(4481) "In 1898 or 1899 I had charge of the construction of riveted pipe by the Risdon Iron Works for the Contra Costa Water Co."

(4686) "Referring to the pipe laid for the Contra Costa Water Co. from the glue works, I surveyed the line, and made a profile, and reported to the company the minimum thickness of pipe, and the size of the pipe that would be necessary to carry that water. * * * It was nearly all of it laid in a trench, and was not very good work, although sufficient for the purpose. It was not as permanent work as the Spring Valley work. It leaked, but not very badly. It leaked because it was fairly thin pipe, and the joints were not tight, nor was the work especially well done. If I were manager of a water works, I should prefer to do better work."

(4687) "The longitudinal seams were double riveted; they were rather light; and not especially well spaced. The efficiency of the joint was sufficient for the purpose; it did not burst."

(4688) "I got no written quotations on riveted pipe to use for the purpose of making my appraisal. I do not keep track of the market prices. I have not paid very much attention to quotations, as I do not regard them as of very great value."

(4693) "I have never had any wrought iron manufacture inspected."

(4698) "I have not figured on the riveting of any of the Spring Valley pipe lines as to strength, as compared with the strength of the plate."

Dillman's estimate upon the riveted pipe lines, is therefore on par with Dockweiler's, and entitled to but little, if any, greater weight.

(4414) "MR. DILLMAN: A. I have not received any quotations on either steel or iron pipes recently, but this estimate is based on the costs of pipe manufactured, coated and laid alongside the trench at 5c a pound or $100 per ton. If the sheets are bought they are bought by the long ton and that 12% accounts for some loss in manufacturing. [Later he has doubts about the accuracy of his statement that the trade uses the long ton, and it appeared that he was mistaken in his assumption, which gives further evidence of lack of information on this subject.] $100 a ton for manufactured steel pipe along the trench is somewhat more than would be paid for steel during the period from 1907 to 1913. I assume that it was enough to buy wrought-iron pipes."

Dillman states that he used the thickness of the pipe given in the inventory, but is in doubt as to the gage which he used, whether Birmingham or United States gage. (4428-9).

(4429) "MR. McCUTCHEN: Q. * * * Can you give us the details at which you arrived at that 5 cents?

"MR. DILLMAN: A. That was taken from my memory and impressions of the cost of that kind of pipe at the trench. If I

were to attempt to divide it I would say that it would be divided about 3½ c on board cars in San Francisco, and 1½c for manufacturing, coating and hauling; about $30 a ton for that part of it.

"Q. Were you figuring then on steel pipe, or on wrought-iron pipe? A. The cost is a little bit excessive for steel pipe; if it is too low for wrought-iron pipe the estimate is low by that amount, whatever it is. At the time I made the estimate, I believed, and I still believe that these figures will do the work. I want to say in this connection that there is not any fixed price of material at any one time; all the quotations that one can get from dealers for the purpose of estimating, will be cut, and sometimes very materially cut, when you come to buy the material. For that reason I have paid much less attention to quotations than if I had not fully understood that fact. That applies to all material going into work of this kind."

Dillman refused to attempt to segregate his 5c estimate for the cost of furnishing the material and fabricating the riveted pipe. (4430-1).

He ridicules the possibility of inspecting the metal under construction at the big steel mills, states that the buyer gets the commercial product of the mill, regardless of his specifications (4483-85, 4698) and that "This thing of specially made material is a good deal of bunk" (4484), which is quite contrary to Mr. Hazen's statement of his own personal experience in this matter.

Dillman admits that he has not read any of the specifications under which the Spring Valley pipes were made (4485).

When asked what kind of wrought-iron he had in mind in estimating the reproduction cost of these pipes, he states (4692): "There are a great many kinds of wrought-iron, but the standard of wrought iron that I have had quotations on, not recently, and that I thought of using, was known as the Allan Wood iron. I was rather surprised to learn that that was the only factory rolling thin wrought iron sheets; I supposed that there were others; that is the standard of wrought iron in my experience."

It will thus be seen that Dillman's experience, like Dockweiler's, was so limited in this field that he was not aware of the fact referred to by Mr. Hazen that the term "Allan Wood iron" was neither generic nor specific and that under it steel plates were often furnished in place of true wrought iron.

Differences In Weight Schedules:

Comparison has been made, in the following schedules, of the "Weights of Uncoated Riveted Pipes"—largely wrought-iron pipe—as estimated by the various witnesses, based upon the "Major Group Schedule of Riveted Pipes Outside of City."

I now present Tables 3 and 4. Table 3 shows the total weight in pounds uncoated as estimated by the various witnesses, Hazen, Dorward, Dockweiler and Dillman, and the percentage which the estimates of the latter three bear to Hazen's estimate.

Table 3.

Estimator	Total weight in pounds uncoated.	Less than Hazen's in pounds.	Percentage.
1. Hazen	25,573,000	.....	.....
2. Dorward	24,863,000	710,000	2.8%
3. Dockweiler	25,228,000	345,000	1.3%
4. Dillman	23,246,000	2,327,000	9.1%

Table 4 gives in detail the comparison of the weights of uncoated pipes showing the different pipes and the estimates of the various witnesses.

[Table inserted opposite]

This comparison, which is made upon a slightly different assumption by the various estimators covers approximately 74.4 miles of riveted pipe of diameters from 12″ to 54″, and thickness from No. 6 gage (0.203 inches) to 0.375 inches, largely wrought-iron, the total weight being estimated by Hazen at 33,754,000 pounds; by Dockweiler at 33,170,000 and by Dillman at 30,892,-000;—Dockweiler's and Dillman's amounts therefore being respectively 584,000 and 2,862,000 pounds, and 1.7% and 8.5% less than Hazen's.

Table 4

COMPARISON WEIGHTS OF UNCOATED RIVETED PIPES

Riveted Pipe Outside of S. F. S. V. W. Co.

Inventory Pg.	Str.	Name of Line	Dia. in ins.	Thickness in ins.	Hazen			Dockweiler		Dillman		Dorward	
					Length in ft.	Wt. per ft.	Total Wt.	Wt. per ft.	Total Wt.	Wt. per ft.	Total Wt.	Wt. per ft.	Total Wt.
						Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
4	25	Pilarcitos Aqueduct	44″	3/16	730	101	73,700	100	73,000	97	70,800		
5	27	" " Siphon	22″	3/16	720	50	36,000	51.78	37,300	47	33,800		
5	29	" " "	22″	3/16	2,495	50	124,900	51.78	129,400	47	117,500		
5	31	" " "	22″	3/16	1,249	50	62,400	51.78	64,700	47	58,700		
9	26	Stone Dam Aqueduct	44″	3/16	2,109	101	213,000	100	210,900	97	204,600		
21	11	San Andreas Pipe Line	44″	# 7	2,044	101	206,400	100	204,400	97	198,300		
		" "	44″	1/4	26,851	141	3,782,000	140	3,759,100	125	3,356,400	137	3,678,600
		" "	37″	1/4	1,414	115	162,600	114.14	161,400	108	152,700		
22	15	" "	30″	# 12	39,820	46	1,831,700	40.60	1,616,700	37	1,473,300		
23	20	Conduit to O. V. Pumps	30″	# 9	27,467	60	1,648,000	59.19	1,625,800	63	1,730,400		
24	25	San Andreas Old Fore-Main to Millbrae	30″	1/4	1,534	92	141,100	93.80	143,900	86	131,900	94	144,200
33	1	Crys. Spgs. Pipe Line	44″	# 7	6,831	101	689,900	100	683,100	97	662,600		
			44″	# 6	33,468	109	3,648,000	109	3,648,000	102	3,413,700	106	3,547,600
34	4	Crys. Spgs.-Millbrae to University Md. Res	44″	# 7	15,308	101	1,546,100	100	1,530,800	97	1,484,900		
			44″	# 6	31,460	109	3,429,100	109	3,429,100	102	3,208,900	106	3,334,800
			36″	# 7	297	83	24,700	83	24,700	75	22,300	83	24,700
55	80	Millbrae Pump Suction Line	30″	3/16	4,273	69	294,800	69.84	298,400	63	269,200		
80	8	Niles Aqueduct	36″	# 9	5,611	72	404,000	70	392,800	60	336,700	68	381,500
91	25	Pleasanton Pipe Line Sunol	30″	# 12	27,400	.....	1,100,000	40.60	1,112,400	37	1,013,800		
129	4	Alameda Pipe Line	36″	# 7	40,464	83	3,358,500	83	3,358,500	75	3,034,800	83	3,358,500
			36″	# 9	14,784	72	1,064,400	72.70	1,034,900	60	887,000	68	1,005,300
			36″	1/4	251	110	27,600	111.02	27,900	97	24,300		
136	24	Alameda Pipe Line Ravenswood to Belmont	36″	1/4	307	110	33,800	111.02	34,100	97	29,800		
			36″	# 7	18,880	83	1,567,000	83	1,567,000	75	1,416,000	83	1,567,000
			36″	# 9	32,455	72	2,336,800	72.70	2,271,800	60	1,947,300	68	2,206,900
138	34	Alameda Pipe Line—Belmont	36″	# 9	34,376	72	2,475,100	72.70	2,406,300	60	2,062,600	68	2,337,600
		Pumps to Millbrae	54″		16,757	190	3,183,800	181	3,033,000	195	3,284,400	186	3,116,800
		Pump	36″	1/4	55	110	6,100	111.02	6,100	97	5,300		
172	113	Belmont Pump Station	36″	3/16	1,781	83	147,800	83	147,800	75	133,600	83	147,800
		Rec. Dist. Sys	30″	5/16	1,076	115	123,700	116.86	125,700	108	116,200		
			30″	1/4	120	92	11,000	93.80	11,300	86	10,300	94	11,300
Total:		Comparable items, Hazen, Dockweiler and Dillman					33,754,000		33,170,300		30,892,100		
		Comparable items, Hazen, Dockweiler, Dillman and Dorward					25,573,300		25,228,200		23,245,900		24,862,600

Note:—

Hazen's weights cover the straight pipe, plus an allowance of 3% for loss in manufacture (p. 4710). 1% for added weight of metal in bends, manholes, blow-offs (p. 4308) and other special requirements (p. 4710).

Dockweiler's weights cover straight pipe, and an allowance of 3% to carry **overhead** as he termed it (but evidently intended to cover loss in manufacture) (4433). He made no allowance in his pipe weights to cover manholes, bends, etc., but his estimate of these items in the inventory showed amounts approximately, but less than 1%.

As limited to the scheduled sizes of riveted pipe estimated upon by Dorward, the comparative weights with the amounts and percentages less than Hazen's figures, are shown in Table 3, which like Table 4 is made upon slightly different basic assumptions by the several estimators.

It will now be shown that the total weight of riveted pipe outside of the city estimated by the engineers for the plaintiff and the defendant alike, are substantially identical and equal to Hazen's figures, when reduced to a common base,—the apparent discrepancy being due to the treatment of the waste in fabricating the plates into pipe, and the excess weight over that for straight pipe to be allowed for on account of bends, reinforcement, etc., in the line as actually laid; all of the witnesses recognize that excess weight of plates is required to cover the waste, bends and reinforcement, etc.

Hazen's estimate was based upon the records of actual weight heretofore determined by Lawrence, a large number of gagings by Hazen, and his past experience in such matters in a large number of other cases (4308, 4442, 4464, 4711-2, et al). He allowed, in excess of straight pipe weights, 3% for waste (4308) and 1% for bends, etc. (4308) and called special attention to the misleading practice of the Spring Valley Water Company of reporting the weight of pipe exclusive of the actual excess weight of the plates, of the rivets—4% of pipe—and of the bends, manholes, reinforcement, etc., which in the aggregate, amount, he stated, to approximately 8¼% (4330, 4526, 4533).

Dockweiler computed theoretically the iron in the barrel of the pipe, including allowance for the rivets (4441) and added 3% in excess of the theoretical weight "to carry overhead" in effect for waste, and in answer to Mr. McCutchen's question,—"You mean the 3% would be lost in fabrication", he says,—"Well, I don't know what happens to it, but that is what you have to do; that is what the best men who are skilled in this shop

work and who buy the plates inform me and I followed their advice." (4441).

Dockweiler made no direct addition to weight to cover bends, reinforcement, etc., as did Hazen—who allowed 1% of the straight pipe weight—but he did later make some provision for these in his estimated fabricating costs and further provision in certain items of his inventory (Def. Exh. 121) covering miscellaneous structures,—the former substantial but unknown in amount, the latter slightly exceeding 0.2%. It seems probable that his total allowance must have been about 1%. Therefore, if Dockweiler's allowance for the bends be included in his basic pipe weights, in order to make them comparable with Hazen's and as should logically have been done, his figures are virtually in absolute accord with Hazen's.

Speaking upon this subject Hazen said,—

(4442) "My understanding is that Mr. Dockweiler allowed 3% for loss in weight in manufacture, which was the same percentage that I allowed."

(4442) "THE MASTER: That is what he means when he speaks of 3% overweight?

"MR. HAZEN: I think so. Then I allowed 1% for the miscellaneous metal work along the line not included in the weight of the straight pipe, and he did not add that, but he estimated the bands separately. So by taking that into account, my figures being very slightly, not more than 1% different, I think there is absolute accord. Mr. Lawrence's figures of course do not make those allowances, so that he expected to be lower, as it is, somewhat lower."

As previously stated Dockweiler's weights were but 1.7% less than Hazen's on the total amount, and 1.3% less on the weight when limited to the scheduled size of riveted pipe estimated upon by Dorward. Therefore, when correction is added to cover the bends, reinforcement, etc., his weight becomes substantially identical with Hazen's.

Dorward's estimated weights, for the scheduled size of riveted pipe covered by him, are based upon straight pipe, without allowance for waste or for bends, as appears clearly in the Master's summing up of Dorward's statements upon this subject.

(4928) "THE MASTER: These final figures of course of reproducing do not include coating, trenching, backfill, fittings for attaching same, and he has now stated that they do not include bends; that is, it is for straight pipe, and does not include profits."

Moreover, Dorward's weights were determined by weighing the pipe after it was finished (4908), under which circumstances the waste material and the straps and reinforcement, used in bends, etc., would not be accounted for.

Dorward subsequently submitted evidence upon the cost of making manholes and the straps for the pipe, which he figured at .00055 per pound as the record reads (6016). Hazen clearly showed, however, (8298-8300) that "this conclusion of Dorward's ignored the principal item of expense [referring to the bends.] His figure of .055 of a cent per pound, and my figure [0.304c] are not comparable, they do not figure the same work at all." (8299)

It is clear, therefore, that to Dorward's estimate must be added substantially the entire amount of Hazen's estimate for bends, etc., of 0.304c per pound.

As has been previously stated, Dorward's estimate of the total weight in pounds of the scheduled size of riveted pipe established upon by him was but 2.8% less than Hazen's. If, therefore, addition be made to Dorward's figures to cover the material waste in manufacture, as well as that used in making the bends, his revised figures will slightly exceed those of Hazen.

Dillman's riveted pipe weights (4416) were made up from an office chart, which he had used in his private practice for making approximate preliminary estimates (4421) which he says was based

originally upon weights of pipe actually manufactured and which do not include extras or coating (4701).

From his direct evidence and cross-examination on this subject, it is clear that the weights assumed by him do not bear any definite relation to the actual weights of the Spring Valley pipe lines. The divergence of his weights from Hazen's weights amounting to 8.5% of the total schedule of riveted pipes outside of the city, and 9.1% of the scheduled size estimated upon by Dorward gives further evidence of the rough and ready character of Dillman's estimate.

It is to be noted further that while Hazen and Dorward recognize and give heed to the difference resulting from buying pipe by gage, instead of by weight, this fact was beyond the experience of Dockweiler and Dillman.

Conclusion as to Weight of Riveted Pipe Outside of City:

We submit that Hazen's estimate of the total weight of riveted pipe outside of the city, 33,754,000 pounds, is conservative and is fully sustained by the estimates of the defendants' own witnesses.

It may not be out of place in passing to call attention to this further evidence of the care and intelligence with which Hazen's work was done, and to note that the information, adduced by him in this matter for the assistance of the court, was distinctly more reliable and in accord with the facts, than that submitted by the engineers for the defense.

Special reference to, or analysis of the testimony of Elliott and Lawrence has not been made, inasmuch as the data collected and the evidence submitted by them formed a part of the basic information used by Hazen in his analysis.

Cost of Metal:

I come now to the cost of metal. Hazen adopted an average price of 4c per pound f. o. b. San Francisco, for the plates, largely wrought iron, of which the Spring Valley riveted pipe

lines were built, as previously discussed heretofore herein (4325-7; 4330; Pl. Exh. 98 e-f-g-h-i-j).

Dockweiler, for the defendant, adopted the same figure—4c per pound for plates f. o. b. San Francisco (4325, 4438, 4452).

Dillman approximated his allowance at 3½c per pound (4429) but as previously shown, was not posted upon the difference in quality of metal and manufacture of pipe lines, or upon recent prices.

Dorward gave no evidence upon the cost of wrought-iron plates.

We submit, therefore, that the allowance of 4c per pound f. o. b. San Francisco, as a fair cost of the metal used in the construction of the riveted plates of the Spring Valley Water Company has been established.

Fabrication Costs:

I come now to fabrication costs. Hazen based his judgment upon riveted pipe fabrication costs upon three lines of evidence: the first, the basis worked out in his office, and which was used in the American Civil Engineers' Pocketbook; second, actual contract prices of steel pipe in comparison with the prices of steel at the time, the cost of manufacture being ascertained by itself; and third, the Spring Valley records and experience. (4335; Pl. Exh. 98-j p. 1).

On the first basis, he finds the cost of fabrication, including hauling and transportation, and excepting the freight and the contractor's profit, of the Spring Valley pipe, which averages 3-16″ in thickness, 3c per pound. (4335-6; Pl. Exh. 98-j, pp. 1-2).

Upon the second basis, by study of the records of contract costs, and comparison of these with the cost of steel plates, upon fifteen recently built large pipe lines, he finds that the average costs are almost identical with those determined by his office standards (4337-40; Pl. Exh. 98-j pp. 2-5).

Upon the third basis, that of the experience of the Spring Valley Water Company in building 63% of its entire riveted pipe system, of which records are available, and covering a total weight of approximately, 26,215,200 pounds, he finds the actual cost 2.873c per pound, for the fabrication of the straight pipe, including the shop and trench work, excluding the dipping, the transportation from the shop to the trench, the making of bends, manholes, and all other special work for which additional expense was incurred, and excluding, of course, the cost of the metal. (4340; Pl. Exh. 98-j pp. 5-6).

Upon the cost of manufacturing the bends and manholes, and placing saddles for blow-offs and air-valves, he finds the actual cost upon the San Andreas pipe line [involving 3,786,000 pounds of metal] to have been 0.342c per pound; upon the Alameda 54" pipe line [involving a weight of 3,183,000 pounds] 0.266c per pound; and upon the Portland, Ore., pipe lines [involving a weight of 12,881,000 pounds] 0.192c per pound, the average of the three items being 0.267c per pound, and of the two Spring Valley pipe lines, 0.304c per pound,—which latter he adopts as the fair cost of manufacturing bends and manholes and placing saddles for blow-offs and air-valves. (4341-2; 98-j pp. 7-8).

The agreed cost of dipping pipe (Hazen and Dockweiler, May 14, 1914) was accepted by Hazen as being 1c per lineal foot per inch diameter of pipe coated with double dip, varying from approximately 0.3c to 0.53c per pound of metal in the uncoated pipe, the weight of the coating being approximately 9.4% of the metal. (4342-3; 98-j pp. 9-10).

The cost of transportation from the shop he finds to have varied from $3.60 to $4.15 per ton, the average of the three available records being $3.90 per ton. (4343; Pl. Exh. 98-j p. 11).

Adding these various amounts together he finds the cost of fabrication, including dipping, transportation from shop to trench, cost of manufacturing bends and manholes, and placing saddles for blow-offs and air-valves, to have been 3.82c per pound (4344

et seq; Pl. Exh. 98-j pp. 11-12), and summarizes these comparative figures (Pl. Exh. 98-j pp. 15-16-17) concluding, as to the cost of manufacture, "that in view of all the circumstances as developed in the above analysis, the average cost of 3.75c per pound for metal used, including plates and rivets, may be taken as the cost of manufacturing, including the making of all pipe in the shop, dipping it, transporting it from the shop to the trench, and making the joints in the trench, and caulking them. For that part of the pipe in the system, where slip joints are used, without attempting an analysis of the saving, a deduction of 1c per pound may be made. * * * For these pipes, which are built as conduits, that is, with less than the full amount of riveting, and without full caulking of seams, a deduction of 1c per pound is made; for slip joint pipes built as conduits, two deductions of 1c each may be made, reducing the cost of manufacture to 1.75 cents per pound." (4352-3; Pl. Exh. 98-j p. 16).

The above estimates are exclusive, however, of the cost of the gates, air-valves, blow-offs, bends, lead joints, connections, concrete in trench, contractor's extras, and all ordinary accessories and contingencies, which he covers later by a 10% over-all allowance upon the cost of the pipe line. (4356; Pl. Exh. 98-j p. 18).

In comment upon the figures assumed by him, Hazen says further:

"There are too many pipe-shops in California. There is not business enough to go around. The state of the local market here with respect to that and with respect to other conditions is much what we had in the East in the '90's when I began my professional work. The first few years of my experience were in hard times and on a falling market. Generally speaking every piece of work was done for less money than its predecessor and we kept cutting our estimates down and down following the cost. About 1897 I was making estimates for quite a number of pieces of work. In 1898 it was decided to build two of the pieces of work

for which I made estimates. The work was started and just about that time the hard times were over, and people wanted to do things, prices rose, and one piece of work for which I had made estimates was carried out at a cost of more than 50% in excess of my estimate; another large piece of work was hung up entirely because the advance was so much above my estimates, but it was finally carried out by another engineer some years later at about double the price I had estimated. Now, my estimates had been sound as based upon the data I had at the time, but I had not taken into account the fact that they were based on hard times conditions, on a falling market, on an excess of capacity and on undue competition. Now, I recognize that it is possible to get from the records of the last few years, since 1913, to get very low prices for pipe in California; on the other hand, if you go back a few years, to the earlier period that is covered by the rate suit and to a time when business was not depressed, you will find prices that are a great deal higher than those that I have used. You can support just as good a schedule on that basis as you can on the other. For this purpose I do not think it is fair to take the low prices and I do not think it is fair to take the high prices. You have to look at them all. There has been at least a two to one range between the high ones and the low ones and it is a matter of judgment where the fair price would come. I have estimated it just as fairly as I can. I recognize perfectly that you can go out and get local quotations that go away under my figures."

Dorward testified upon detailed fabricating costs. His evidence thoroughly supported Mr. Hazen's 3.75c-per-pound cost of fabricating riveted pipe, as will be shown, and completely discredited the estimates of defendants' other witnesses upon this work.

In Def. Exh. 103, Dorward gave the detailed basis and upon pages 7, II and I, A to F, thereof, his summarized conclusions as to,—first, the cost to the Risdon Iron Works of fabricating and laying the Spring Valley pipes made by them, including the

making, laying, transporting, cleaning and attaching fittings, but excluding coating, trenching, and backfilling and cost of fittings, though he admitted that his records consisted of private notes made in the shop and were not based upon final cost figures taken from the books of the company (4893); second, prices paid by the Spring Valley Water Company for making and laying riveted pipes, including the use of dipping kettles, but excluding transportation, handling, coating, attaching fittings, trenching and materials; and third, cost of reproducing the Spring Valley pipe lines, including making, laying, transporting, hauling and cleaning ends, but excluding coating, trenching, backfilling, material, fittings and cost of attaching same, all as limited to six pipe lines varying from 30-inch to 54-inch in diameter, 0.163-inch to 0.281-inch in thickness.

But in his reproduction cost figures Dorward definitely excluded allowance for the excess metal consumed, waste of material in fabrication, and in making bends, manholes and fittings, and for cost of coating, trenching, backfilling, overhead costs upon plates and material furnished by the Spring Valley Water Company; shop profits; and water company overhead and interest-during-construction (4909; 4920; 4928 et al).

Dorward based his reproduction cost figures fundamentally upon his estimate of the change in labor prices and efficiency, stating that "the wages increased from 1884 to 1913 12%; * * * that reduced the hours of work in the factory 20%, so that made an increase of 32% in the cost to reproduce it in 1913; then in the field that increased our wages 12%, and reduced the hours of labor 10%." (4917).

He admits that while the labor of today has brains, it does not use them in the interest of the employer (4918), and as to the comparative cost of doing such work in the east and the west he says, "The wages in the east are considerably less and the hours of labor longer, but men here will do more work per day than they will do in the east, due to climatic conditions principally; in

winter time they are freezing, and in summer time they are roasting, but here the men work in their shirt sleeves the year round, and consequently they do more work. * * * Probably paying about 10% more wages here and working 10% shorter hours than they do in the east, but deducting from that again, the extra amount of work that men can do here, amounting to about 10%, would make the eastern pipe from 10 to 12% cheaper than it could be manufactured here, but against that you should consider the cost of transporting the finished pipe to the coast, against transporting the raw material practically out here * * * but altogether without the figure I should say that the eastern pipe would be 10% cheaper, 10% to 12% cheaper than the pipe made in California." (4922).

As to the effect of unionism upon labor efficiency, hour per hour, Dorward considers the efficiency of the man in 1913, probably not over 75% of that 10 years ago. (4929).

In order to make Dorward's riveted-pipe-fabrication figures comparable with Hazen's, it is necessary to make addition for omitted elements of cost which were all admitted by Dorward, though he did not cover them in his estimate shown in Def. Exh. 103, to-wit,—the allowance for making bends, manholes and fittings, for the pipe coating, for the overhead cost of materials ordered and furnished to the pipe shop by the Spring Valley Water Company, and for the shop profit. The fair allowance for making bends, etc., 0.3c per pound, has already been discussed in the light of Dorward's and Hazen's evidence. The pipe coating costs were agreed to by Hazen and Dockweiler and accepted by Dorward on the basis of 1c per inch in diameter per linear foot of pipe, which is equivalent to an approximate variation from 0.3c to 0.5c per pound of bare metal upon the pipe lines to which Dorward limited his estimates.

Upon the shop overhead and profit, Dorward's evidence was less conclusive, owing to the fact that his figures were not based upon specific knowledge of actual past costs upon different con-

tracts, but rather upon the margins that the shop normally figured and strove to earn. His shop overhead was fixed at 50% upon the labor items, excluding his usual 10% shop overhead upon materials, because of the fact that these were furnished to the shop by the Spring Valley Water Company. The cross-examination upon this point (4893-4906; 4918-21; 5993-4) clearly established the fact that either Dorward should have made allowance for the shop overhead upon the materials furnished by the Spring Valley Water Company, or a similar allowance on account of the costs to which the Spring Valley Water Company would be, and was, in fact, put in the ordering, inspecting and delivering of this material to the pipe shop, costs which have not been provided for either by plaintiff's or defendants' witnesses in any other way.

MR. SEARLS: Is not that included in the 4 cents, Mr. Greene?

MR. GREENE: No, not at all, not the cost of the metal.

MR. SEARLS: But it includes the inspection of the metals when made in the east, doesn't it?

MR. GREENE: I don't understand it so at all.

MR. SEARLS: I certainly do, at least so far as Mr. Dockweiler's testimony is concerned.

MR. GREENE: But not so far as Mr. Hazen's testimony is concerned.

If Dorward's 10% allowance were to apply to the cost of the material delivered f. o. b. San Francisco, this would amount to 0.4c per pound—

MR. McCUTCHEN: I don't understand that that 10% covered items of that kind at all, Mr. Searls, that is to say, with the Risdon Iron Works, but that the allowance was made from the time the plates reached there for the fabrication; wasn't that it? I don't understand that that was for eastern inspection.

MR. SEARLS: Even so, if the Spring Valley Water Company

delivered the plates there to them they didn't have to incur these overhead expenses.

MR. McCUTCHEN: So when the Risdon Iron Works bought plates it made an allowance of 10%, and that allowance, as I understood it, was for the service of the Risdon Iron Works from the time the plates reached its factory and did not cover any expense incurred in the east; I might be wrong about that but I don't think I am.

MR. GREENE: It is my impression, Mr. McCutchen, that you are wrong about that; I am not positive of it though. I think under Mr. Hazen's discussion the 10% would cover expenses which the Risdon Iron Works would be put to for the inspection in the east if it had not been done by the Spring Valley Water Company.

MR. McCUTCHEN: You may be right, Mr. Greene, but that is not my understanding of it.

MR. GREENE: If Dorward's 10% allowance were to apply to the cost of the material delivered f. o. b. San Francisco, this would amount to 0.4c per pound, but it is possible that he would have based this percentage upon the price of the metal at the factory, in which case it would have amounted to 0.33c per pound, or even that he might have modified this figure still further. It is clear in any event that a substantial allowance should be made to cover this element of cost, which is not allowed for by Dorward in his estimate shown in Defendants' Exh. 103.

Upon the fair allowance for shop profit Dorward gave conflicting testimony. At first he stated (4919), "that we could not get the same profit in 1913 as we would have got 10 or 15 years ago; * * * you take [in 1913] the actual cost and add 30 or 35% at the outside and it would be all you would expect to get. In those days 50 to 60% was the profit, but today you cannot get any such profit on account of competition", and he states further that he made no profit allowance in his basic figures. (See also 4920-1).

(4921) "MR. McCUTCHEN: Q. What percentage of profit would you add under the conditions in 1913 on a job like this?

"MR. DORWARD: A. 30 to 35%.

"Q. Suppose you were to go back to 1907 to 1914, what profit would you add, Mr. Dorward, take that seven or eight years?

"A. In those days competition was never as fierce as in 1913, and you would get much better profit; there was a living profit in the business then.

"THE MASTER: When did the conditions that prevailed in 1913 begin?

"MR. DORWARD: A. Back, I should say, about 1910 we commenced to feel it.

"Q. 1907, 1908 and 1909 were good years? A. Up to 1909 were good years; we got a good profit. From that time on there were very few establishments making any profit."

Later, when recalled by Mr. Searls, after looking up some of his original records, Dorward modified his testimony (5952a-6002), and summed up his change in view in the following answer to Mr. Searls' question (5958),

"Now, Mr. Dorward, in view of your investigation since the last hearing, what do you now say would have been the reasonable profit for a manufacturer of pipe such as the Risdon Iron Works to have received for fabricating and laying that pipe during the years from 1907 to 1913?" Answer. "Not to exceed 15%. * * * When I said 30 to 35%—at the last hearing—I had not given the matter any serious consideration, merely an estimate on my part, without going deeply into it. Since then I have gone more thoroughly into it, and investigated what the probable profit would be."

On his own statement Dorward's first position fixing the profit at from 30 to 35% was clearly an expression of his experience and recollection as to the general profit conditions in such work, while his second statement, limiting the profit "not to exceed 15%", was clearly the result of his attempt to interpret

the figures, looked up and submitted by him, upon the profit items in certain riveted pipe work contracts with which he was familiar, which ranged from 12 to 17%, when based upon the combined cost of labor and materials, but which percentages were substantially doubled in amount when predicated upon the labor cost alone, as was drawn out in Dorward's cross-examination. (5956-8; 5992).

MR. SEARLS: What earthly ground is there for predicating them on the labor cost alone? That is what I would like to have counsel explain.

MR. GREENE: I will quote from the testimony in order that it may be before your Honor and in order that the facts as developed from Mr. Dorward may appear. I am quoting now from page 4900 of the record.

(4900) "MR. SEARLS: Before I ask Mr. Dorward any further questions I had better turn these note books over to counsel. I would like to ask one question of Mr. Dorward as a preliminary to that.

"Q. From your knowledge of the Risdon Iron Works, their methods, would you say that these figures are more or less reliable, than the books of the company as showing the true cost of this work?

"MR. McCUTCHEN: I object to that if your Honor please, as calling for the opinion of the witness. He does not know anything about the books.

(4901) "THE MASTER: I will let him answer that.

"A. Whether my costs are more accurate than the Risdon's books?

"MR. SEARLS: Q. That is, more reliable as showing the true cost of this work? A. They show the true cost of the work, whether the books show the true cost of the work I am unable to say.

"THE MASTER: Mr. Searls, when you are speaking of the costs of the work, you mean costs to the Risdon Iron Works

without profits? The cost of the work is shown by whatever the Spring Valley Company paid.

"MR. SEARLS: I am speaking of the cost to the Risdon Iron Works.

"THE MASTER: Which would differ from the other costs by the amount of the Risdon Iron Works profits on the contract.

"MR. SEARLS: Yes.

"THE MASTER: Then, Mr. Dorward, in these figures that are contained in this table there is no addition to the 50%?

(4901) "A. Yes, 50% is in the costs that I made up. I took the actual wages paid at that time and added 50% to the wages only.

"MR. McCUTCHEN: Q. Not to the material?

"A. No, we usually used to add to the material we bought; to the material that was brought into the works we added 10% for handling and odds and ends, but the labor was taken at the payroll rate plus 50%.

"MR. SEARLS: The material was furnished by the Spring Valley? A. In this case it was. Most all the Spring Valley pipe was furnished by them, so that that 10% would not be applicable to the Spring Valley?

"MR. McCUTCHEN: Q. That is to say, when you bought (4902) the material and fabricated it you charged 10% on the cost of the material and 50% on your labor costs, did you?

"A. That is, if we bought the material, yes.

"Q. If you did not buy the material—

"A. We did not add anything to it.

"Q. You did not add anything except the 50%. Was there anything added for profit after that? A. Yes, quite a profit —quite a big profit was added.

"Q. In cases where you purchased the material and added 10% you figured your profits, did you, on the material as well as on the labor? A. If we bought the material we added 10% and called that cost; the labor, the pay-roll labor, with the

50% added was the labor cost; to that, the sum of those two was added a certain percentage for profit.

"THE MASTER: Q. Then this 50% does not include the shop's profit? A. No.

(4902) Q. That was to cover contingencies and power? A. Power, clerks and office force.

"Q. Overhead generally? A. Overhead, called overhead."

* * *

(4903) "MR. SEARLS: Do you wish to cross-examine him on the source of his information before we go ahead with the figures?

"MR. McCUTCHEN: Yes, I have one or two questions.

"Q. You say that when you purchased the material you added 10% to it and called that cost? A. That was the usual practice.

"Q. Why was that 10% added? A. There was a certain amount of handling by the store-keeper to be taken care of, and there were men in the yard-gang handling it, so that we figured it required 10% to pay for that cost of handling.

"Q. Now, Mr. Dorward, didn't you handle the Spring Valley plates just as you would have handled the plates if you had purchased them? A. The Spring Valley plates on the 54-inch-pipe came in by rail right in to our manufacturing department and were hoisted off out of the cars there without extra expense.

"Q. There was some expense for that, was there not,—for that handling? A. That was included in the making of pipe.

"THE MASTER: Mr. McCutchen wants to know why you did not add your 10% for material since the only difference appears to be that in one case the Spring Valley Company paid the material bills and in the other case the Risdon paid the material bills?

(4903) "A. The Risdon did not pay any material bills for the Spring Valley pipe except some small lots.

"Q. But he wants to know why the overhead of 10% was

not included whether they paid for it or not? A. Because that was brought into the works, as I say, by rail, and the shop work was so arranged that the material was handled at a very small cost, and that was included in the making of the pipe. In previous pipes, the 44-inch and 36-inch, the Spring Valley delivered the material in our works—

"MR. McCUTCHEN: Q. Mr. Dorward, suppose you had bought the plates and had had them transported here for fabrication, you would have added 10% of that cost, wouldn't you?

"A. Yes, usually.

"Q. That is to say, you would have taken the aggregate of the cost of the plates in Pittsburg, if you had bought them in Pittsburg, plus freight from Pittsburg to San Francisco, and to that aggregate you would have added 10%, would you not?

"A. Yes.

"Q. The cars on which these plates were loaded would have been switched right into your yard just as the Spring Valley cars were, wouldn't they? A. $2.50 per car switching charges.

"Q. You would have added that to the cost, wouldn't you?

"A. That is cost.

"Q. That is to say, that would have represented you say the cost, and to that you would have added 10%? A. Yes.

"Q. So far as the delivery of plates to the Risdon Iron Works' place of business was concerned it was identical in the case of the Spring Valley plates with deliveries of plates purchased by the Risdon, was it not? A. No, because the Spring Valley delivered the plates to us.

(4904) "Q. Well, as you say, they had a car switched into your yard on which the plates were loaded? A. That was in making the 54 inch pipe only; the other pipe was built in the old establishment down on Beale and Howard, and they came in by team, all those plates came by team.

"Q. Because you had no spur at that time?

"A. We had no spur at that time.

(4905) "MR. SEARLS: Q. Mr. Dorward, do I understand that that 10% includes a profit on the materials themselves?

"A. No, that is just overhead—cost.

"THE MASTER: Q. That would include teaming charges borne by the Risdon Iron Works, wouldn't it? A. There were no teaming charges with the Spring Valley; they did their own teaming.

"Q. Suppose the Risdon had bought the pipe, would the 10% include the teaming charges, or would you add that to the material bill before you added 10%? A. The cost of the teaming would be added to the cost of the material.

"Q. And then you would add 10%? A. Yes.

"Q. And that covered the wages of the storekeeper, handling and one thing and another around the shop?

"A. General overhead, yes.

"Q. No profit? A. No profit in that.

"MR. SEARLS: It is not clear to us here: what was it that caused you to add 10% in the case of the other pipe and to not add it in the case of the Spring Valley pipe?

"A. Because the Spring Valley delivered the plates, material, to us right in our factory; and in the case of the Risdon (4905) supplying the material they would have to bear the cost of delivering it into the factory.

"Q. Did you include that in the 10%? A. We would include in the 10% whatever the cost of delivery was; if, for instance the team charged $10, there was 10% went on that.

"MR. McCUTCHEN: Q. If the teamster charged $10. for his team in hauling that plate, that $10. represented part of the costs?

"A. Part of the costs.

"Q. And to that $10. you added 10% or one dollar? A. We did.

(4906) "Q. To cover what you call overhead? A. Overhead, yes; overhead on material.

"MR. SEARLS: Q. In the case of the Spring Valley pipes where they brought in the pipes themselves, you did not have to stand that charge? A. No.

* * *

(5992) "Q. Take the San Joaquin Light & Power Company as an illustration: Did you allow 10% on the cost of material there?

"A. Yes.

"Q. What was the profit that you computed on that? A. 15%.

"Q. What was the labor in that case, as compared with the cost of the material? A. The material is 10%,—$26,800.

"Q. And what was the labor? A. $33,000.

"Q. If you had computed that on labor alone, what would the profit be in percentage? A. 10%.

"Q. It would be more than that, wouldn't it? What is the profit in dollars? I don't mean in percentage. A. 15% here on the total job.

"Q. What does that amount to? What is the total job?

"A. The pipe, exclusive of the manholes—

"Q. No, what is the total of labor and materials? A. Labor and material, including the shipping, was $64,521.

"Q. And how much profit did you count on, in dollars?

"A. Nearly $9,000.

"Q. And you say the cost of the labor was what? A. $33,361.

"Q. And what percentage would that be, if you computed it on the labor alone?

"THE MASTER: Perhaps you can compute that on the sliding scale.

"MR. ELLIS: It is somewhere near 27%.

"MR. HAZEN: The profit at 15% is $9,678.

"MR. ELLIS: That is about 29 percent.

"MR. McCUTCHEN: Mr. Ellis, while you have your sliding rule in your hand, in the Tacoma case the bid was $81,500; the

entire cost, according to the statement, was $74,111; that gives a profit of $7,388. The labor was $20,362. Will you give us the percentage on that?

"MR. ELLIS: That is 36 and a fraction per cent.

"MR. McCUTCHEN: Mr. Searls, figuring it in the same method, Mr. Metcalf reaches the conclusion that the percentage of profit on the item of labor alone in the Great Western case would be 34 and a fraction per cent. He has not gone through all of these."

I think we are perfectly willing to leave that testimony with your Honor subject to your Honor's interpretation of it. It is obvious it is not entirely clear, but it seems to me equally obvious if Mr. Dorward is figuring on a job that does not involve the cost of material that his percentage is not going to be the same as it would be with the material involved.

MR. SEARLS: You did not read the first illustration he gave, Mr. Greene, where the profit on labor alone was 15%?

MR. GREENE: Well, I didn't intentionally omit that, Mr. Searls, and I would be glad to have it go in here at this point if you consider that it is enlightening. Of course, it is to be borne in mind that these are estimates and not acceptances of bids all the way through, your Honor, which is another difficulty of arriving at just what Mr. Dorward had in mind. I am perfectly willing, Mr. Searls, to add that in the discussion here, if you have not got it at hand right now. Will you give me the page of it?

MR. SEARLS: Page 5956, referring to the Arizona Power Company job. On the following page he says:

"Q. Was that the profit on the work alone or on the material also? A. The installing [—it] is on the work alone."

MR. GREENE: He says that in the portion I have just read, Mr. Searls, but I understood you to raise the question whether that was done on the work alone or whether the Risdon bought the material.

MR. SEARLS: In this case the Risdon did not buy the material, they only bought the work.

MR. GREENE: I don't get that quite clear. Where is the statement that they did not buy the material?

MR. SEARLS: I will read this:

"Q. You say profit installing, what does that mean?

"A. That was the installing of the pipe.

"Q. Was that the profit on the work alone or on the material also?

"A. The installing,—is on the work alone."

And at page 5957: "Q. Can you state how many of those jobs, Mr. Dorward, involved work alone and did not require you to furnish the material? A. They all involved material except the Arizona Power Company on which the estimate is for laying only, installing."

MR. GREENE: That is right, Mr. Searls; I didn't see that. Mr. Sharon, however, calls my attention to the fact that there was no shop-work in this Arizona Power Company work at all, that it was simply the work of installing, so that that is hardly a comparable job.

THE MASTER: Mr. Greene, have you in your previous discussion compared Mr. Dorward's figures with Mr. Hazen's figures, revising them to suit the interpretation which you say should be put upon them?

MR. GREENE: Yes, your Honor. In the discussion we took Mr. Dorward's figures first on a 35% basis, which was his first testimony as to profit; that brought his figures for fabrication above Mr. Hazen's; we then took his figures on a 15% basis, which gave 3.43 as against Mr. Hazen's 3.75; then we took an average of the 35 and 15 and that brought his figures to 3.68 as against Mr. Hazen's 3.75.

MR. SEARLS: What was the point in averaging them?

MR. GREENE: Simply that we felt it was quite evident from his testimony that Mr. Dorward had fallen a little below,

even after his investigation, of what the obvious influences of the earlier period were. There is no question from his testimony but that from 1907 to 1910 the profits were much higher than the profits when these bids were made in general, and it seemed to us that if he was accurate in his recollection of the method which was used in making up these bids he did not make due allowance for the higher prices which he himself states and which he did not retract in his later testimony that obtained so far as profits were concerned from 1907 to 1910. We thought his Honor in looking over the entire situation might draw some line between the two figures Mr. Dorward gave. I must say that it seemed to us that a person with the experience that Mr. Dorward obviously had, and which we concede, must have misunderstood the exact point in issue in one of the two instances, and his testimony is so clear as far as the general trend of profits are concerned during the period in controversy that we personally feel that the Risdon Iron Works made more than 15% on jobs such as the Spring Valley job. Of course, they obviously did on that job, there is no question about that. I want to be entirely fair so far as Mr. Dorward is concerned, but I don't think that his later testimony can entirely represent the facts.

MR. SEARLS: Without arguing that point with you, his testimony on his first appearance unquestionably corroborates the statement you have just made but his testimony on his second appearance, when he stated he had gone over these estimates made by the Risdon Iron Works, all of which were in the years prior to 1911, when the Risdon Iron Works went out of business, and some of them were in the years 1907, 1908 and 1909, indicate that the profits were only 15% or less. It seems to me that it amounts to a correction of his previous statement. If his Honor is inclined to believe his first statement he has to discard the second one; if he believes the second one he has to discard the first; I don't see how he can average them.

MR. GREENE: I don't want you to get the impression that

Table 5

Analysis of **David Dorward's** (Def. Witness) **Reproduction Cost Estimate**
of
Fabricating Riveted Pipe in Country; and about 5,000 ft. of 30″ Pipe in City, excluding Metal, Materials, Trenching and Backfilling and Water Co.'s Overhead and Interest-during-Construction Expenses as of Dec. 31, 1913.

Based upon Def. Exh. 103.

	Wt. lbs. per ft.	Uncoat. of pipe	Dorward's Costs, cts. per lb., excluding Coating, Trenching, Backfilling, Material (Metal, etc.), Fittings, Bends and Profits.					(*) Adding for Bends and Coating the cost would be cts. per lb. plus profit of		Wt. in Lbs. Dorward	Length in ft. (Invnty) except 6700′30″ x¼ (Def. Ex. 103), p. I. A.	Product of Wt. by	
			Ris. Iron Wrks. Costs	Orig. Cost	Reprd. Cost	Reprd. Cost							
	Hazen	Dorward				35%	15%	35%	15%			Col. 9.	Col. 10
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. 30″x¼″ (0.25″)	92	94	2.24	2.68	2.61	3.52	3.00	4.14	3.62	629,800	6,700	$25,950	$22,800
2. 36″x# 7 ($\frac{3}{16}$″ 0.187″)	83	83	2.27	3.00	2.69	3.62	3.09	4.35	3.82	5,098,000	61,422	221,760	194,740
3. 36″x# 9 (0.163″)	72	68	2.48	3.04	2.95	3.92	3.39	4.75	4.22	5,931,300	87,226	281,740	250,300
4. 44″x# 6 (0.203″)	109	106	1.72	3.05	1.97	2.66	2.27	3.38	2.99	6,882,400	64,928	232,620	205,780
5. 44″x¼″ (0.25″)	141	137	1.53	2.28	1.74	2.34	2.00	2.96	2.62	3,678,600	26,851	108,890	96,380
6. 54″x$\frac{9}{32}$″ (0.281″)	190	186	1.79	2.86	2.10	2.83	2.42	3.42	3.01	3,116,800	16,757	106,600	93,820
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25,336,900	263,884	$977,560	$863,820
Weighted Average.....	.....	.....	.....	.....	.....	.....	.....	3.85c	3.41c	.....	.....	3.85c	3.41c

(*) **Note:**—Add for Bends 0.3c. Coating 30″—0.30c.
36″—0.43c.
36″—0.53c.
44″—0.42c.
44″—0.32c.
54″—0.29c.

Summary:—Dorward's average per pound on basis of 35% to contractor..... 3.85c.
Dorward's average per pound on basis of 15% to contractor..... 3.41c.
If the 35% profit were assumed for the first four years (1907-1910) of the period at issue, and 15% profit for the last four years (1911-1915) Dorward's resulting weighted average figure would be..... 3.63c.

Comparable with **Hazen's Average** per pound..... 3.75c.

Note:—Note further that Dorward's figure **excludes** any allowance for overhead cost upon materials furnished to the pipe shop by the Spring Valley Water Company, upon which material he said the shop ordinarily added 10% overhead, when the material was purchased by the shop (p. 4901-2).

I am doubting Mr. Dorward's testimony. I think that Mr. Dorward is one of the honest witnesses in this case and I don't want to reflect upon him. I think his testimony is significant as to the amount of profit from his department during the years he was with the company. You must remember that these cases are selected cases and they do not represent all of the experience which the Risdon Iron Works had.

MR. SEARLS: I think they represent all the pipe jobs they had.

MR. GREENE: Even if you take pipe jobs they obviously do not represent all the work that the Risdon did. Now, on a general average of profits it seems to me that you cannot square the facts as they were developed by Mr. Dorward in his early examination with as low a percentage of profit as 15. I think the same thing is true in the submerged pipe; his 25% profit on submerged pipe it seems to me is demonstrated to be too low by the actual cost which his firm received when that pipe was laid. I would be glad to hear your arguments on that, Mr. Searls, and when it comes time for me to reply to it I will do so if I can.

In submitting the following table embodying "An Analysis of David Dorward's Reproduction Cost Estimate of Fabricating Riveted Pipe in Country", it will be noted that the necessary additions to make his figure comparable with Hazen's have been made, based upon alternate profit allowance of 35% and 15% respectively, except that no allowance has been made in this table for the element of overhead cost upon materials furnished to the pipe shop by the Spring Valley Water Company, which could not, in any event, exceed 0.4c per pound, as already discussed.

[Table inserted opposite]

The resulting weighted averages of Dorward's cost of fabricating riveted pipe, comparable with Hazen's average price per pound of 3.75c, are as follows: Upon a 35% profit, 3.85c per pound; upon a 15% profit, 3.41c per pound; upon a 35% for

one-half of the eight-year period involved in the rate suit, (i. e. from 1907 to 1910 inclusive) and 15% profit on the remaining half, an average price per pound of 3.63c,—all of which prices exclude allowance for overhead cost upon the materials furnished by the Spring Valley Water Company, which would amount to something less than 0.4c per pound.

We submit that here is further evidence, conclusive in character, of the fairness of Hazen's estimate. Hazen's breadth of experience was not in this instance the handicap counsel has thought it to be.

In view of the lack of experience of Dillman and Dockweiler in this field of engineering construction, and of the character of their testimony upon riveted pipe, to which reference has already been made herein, it is unnecessary to quote their figures, which were, in general, less than one-half of those of Hazen and Dorward.

Excavation and Back-filling:

I come now to excavation and back-filling on the riveted pipe lines outside of the city, and the allowance made therefor by the several witnesses.

Briefly stated the several witnesses allowed the following approximate figures per cubic yard to cover the cost of excavation and backfilling, as applied to the Major Group Schedule, 450,155 cubic yards.

Hazen, 75c per cubic yard, excluding allowance for special obstructions upon the state highway.
85.8c per cubic yard, including allowance for special obstructions upon the state highway.

Dockweiler, 71c per cubic yard, excluding special allowance.

Dillman, 50c per cubic yard, excluding special allowance.

Ellis, 65c per cubic yard, excluding special allowance.
71.3c per cubic yard, including special allowance.

Additional figures were submitted upon actual cost by Elliott and Lawrence; and some contract figures, involved in the con-

struction of the auxiliary water supply (high service fire protection) system built by the city, were submitted by Stocker for the defendant.

The amount of excavation incident to the "Reproduction of 501,422 feet of Riveted Pipe in the 68 Main Items of the Schedule" referred to by Hazen in his Pl. Exh. 98-j, page 18, is given as,—

> "Excavation (including backfilling), earth and rock 572,205 cubic yds. at 75c per cu. yd.....$429,154."

This, however, covered certain of the riveted pipe laid within city limits and must, therefore, be modified to accord with the Major Group Schedule of Riveted Pipe Outside of City, (450,155 cubic yards), to which the present discussion is limited.

The total amount of earthwork excavation and backfilling, involved in the items of the inventory which were grouped in the "Major Group Schedule of Riveted Pipe Outside of City" is 450,155 cubic yards, as appears from Table 6.

Table 6

Inventory Page	Structure Number		Cubic yards
4	25	Pilarcitos Aqueduct	1,058
5	27	" " Siphon	409
5	29	" " "	1,487
5	31	" " "	746
9	26	Stone Dam Aqueduct	3,000
21	11	San Andreas Pipe Line	39,878
22	15	" " "	36,328
23	20	Conduit to Ocean View Pumps	26,756
24	25	Millbrae-San Andreas Force Main (estimated)	1,500
33	1	Crystal Springs Pipe Line	56,478
34	4	" " " "	60,651
55	80	Millbrae Pumps Suction Lines	4,171
80	8	Niles Aqueduct	6,234
91	25	Pleasanton Pipe Line	35,103
129	4	Alameda Pipe Line, Niles-Dumbarton	43,658
136	24	" " " Ravenswood-Belmont	54,819
138	34	" " " Belmont-Millbrae	74,651
172	113	Belmont Pumps, Receiving and Distribution System	3,228
		Total	450,155

With this in mind, I quote from Mr. Hazen:

(4389) "That"—referring to the figure of 75c per cubic yard—"is based on my general experience with public work primarily; in my judgment it is the fair figure for all the work in this case."

(4438; 4563) Similar comments.

(4565) * * * "Was in the state road * * * costs more than doing it elsewhere * * * added 75c a foot for the extra difficulties."

This additional allowance of 75c per linear foot he applies to 64,600 feet involving a total addition of $48,450. (Pl. Exh. 98-m).

If this amount be predicated upon the entire yardage involved in the Major Group Schedule,—to wit, 450,155 cubic yards,—Hazen's resulting addition becomes 10.8c per cubic yard (8.4c per cubic yard on Hazen's 572,205 cubic yards in and outside of the city.) This makes his actual allowance upon 450,155 cubic yards of excavation, 75c plus 10.8c, 85.8c per cubic yard applicable to the Major Group Schedule. (4388-9) Hazen discusses the classification of the material.

In support of his judgment he gives (4390-93) the following cost figures in San Francisco and Portland, Oregon, shown on Table 7. The table speaks for itself; it is not necessary for me to go through it at this time:

Table 7.

		Actual cost Excavation and Backfilling.	Cost based upon Hazen's assumed figures (1913).
1888	36″ Alameda Pipe Line...	$0.47 per foot	$0.86 per foot
1903	54″ " " "	2.66† "	2.25 "
1915	30″ Golden Gate Park Line	23,250* "	21,600* "
1894	37″ Portland, Ore.....	.76 "	.88 "
1911	46½″ Average Portland, Ore.	1.50 "	1.19 "

†Actual cost when brought down to date (1913) $2.96 (W. B. Lawrence Pl. Exh. 99, p. 37).

*This amount covers not only the cost of excavation and backfilling, but the cost of the pipe furnished and laid in place as well.

Dockweiler (4436-8) allowed 71c per cubic yard, which he states is made up of an allowance of 51c for excavation and 20c for backfilling per cubic yard, without any mention of the special difficulties incident to the construction of the work upon the state highway.

This allowance of 71c per cubic yard is therefore comparable with Hazen's of 85.8c per cubic yard and not with his figure of 75c per cubic yard.

Dillman (4416-17; 4420) allowed 50c per cubic yard without mention of any excess on account of the difficult work along the state highway.

Ellis, for the defendant, (4886; 4888; 4997) estimated an average cost of 65c per cubic yard plus an additional allowance of approximately 40c per linear foot, or 26c per cubic yard, excess for the pipe along the state highway. This, he states, when predicated upon 570,000 cubic yards (approximately the amount referred to in Hazen's Pl. Exh. 98-j, p. 18, which covered 68 items of riveted pipe not only outside of the city but inside of the city) amounts to 5c per cubic yard, or if it be predicated upon the Major Group Schedule's 450,155 cubic yards, 6.3c per cubic yard, comparable with Hazen's 10.8c per cubic yard. The sum of these two items, 65c plus 6.3c gives Ellis' total allowance of 71.3c per cubic yard as based upon the Major Group Schedule, which is nearly identical with Dockweiler's figure and comparable with Hazen's figure of 85.8c per cubic yard.

Elliott, superintendent of the city division of the Spring Valley Water Company (Pl. Exh. 149) (7488-91) gave such figures as were available from the recent construction records of the company, which in general, supported Hazen's estimate. They are not cited here, however, as they were very small in aggregate amount and as the segregation of costs was quite different from that used by Hazen, and, therefore difficult of application; thus, while Elliott gave figures for the excavation of sand, hard clay and rock amounting to 40c, 85c and $3 per cubic

yard respectively, it is to be borne in mind that there is to be added additional allowance for timber and bracing, amounting to 35c per cubic yard on a portion of the material only, backfilling 22c, 40c and 50c respectively on the three classes of materials, applied to quantities slightly less than the amount of excavation, an allowance for carting away the excess material 30c per cubic yard, and for miscellaneous items. In view of these facts the data is not believed to be of sufficient significance to warrant a full discussion of it. It was introduced by the company merely that it might not be charged with having suppressed any information in its hands concerning such work, more particularly the recent work.

Lawrence submitted detailed figures (Pl. Exh. 99) of the original cost of excavation and backfilling pipe trenches "resolved", or brought down to date by the substitution of 1913 labor prices, for the labor prices actually paid upon the date of construction. These figures were summarized upon page 37 of his estimate, as follows:

I now present Table 8, your Honor, which shows an average of 102,178 cubic yards at $1.50 a cubic yard.

Table 8.

San Andreas 44″ Pipe Line	$1.83	cubic yard
Alameda 54″ Pipe Line	1.48	" "
Stone Dam Aqueduct 44″ Pipe Line	1.18	" "
Merced Branch San Andreas Pipe Line 30 to 37″	1.07	" "
Average (on 102,178 cubic yards)	$1.50	cubic yard

It is to be borne in mind, however, that these figures of the first two pipe lines mentioned, include the element of excess cost, segregated by Hazen and Ellis, due to the laying of a portion of these pipe lines along or adjacent to the state highway. This fact must be remembered in making comparison between these figures and Hazen's estimates, the conservativeness of which they clearly indicate.

In passing, it may be well to comment upon Def. Exh. 107. The first computation relating to the Pleasanton pipe line involves so small an amount and conditions of such indeterminate character that the resulting analysis is of little aid in establishing the fair cost of excavation. The second analysis purports to cover the contract cost, in 1887-8, for excavation and backfilling of the Alameda 36-inch pipe line amounting to 41.7c per cubic yard; not only is this date remote and the amount of work comparatively small, but more important, Lawrence states that "The man that had the contract with the Risdon Iron Works went broke." (5333) To apply a multiple of excess cost, to cover the change in conditions between 1887 and 1913, to a price originally unfairly low, is but to multiply uncertainty.

Stocker, witness for defendant, submitted in Def. Exh. 100-jj an estimate of cost of trench work (excavation and backfilling) incurred on the auxiliary water supply (fire protection) system of the City of San Francisco, "With wages corrected to $4 per day average rate for foreman, $2.50 for common labor, and $6 for teams; does not include cost of opening asphalt pavements and concrete pavement foundations and not the cost of replacing same." Table 9 contains the figures:

Table 9.

District	Sand	Sandy Clay	Hard Clay	Soft Rock
1	$0.91	$1.03	$1.15	....
2	.82	.94	1.05	$1.16
3	.43	....	.99	....

These figures he reduced by 10% more or less, in order to exclude the hauling away of surplus earth and other adjustments, without apparent justification and certainly without any other allowance to cover other hazards or costs which ought to be anticipated on the conduit lines.

He also submitted, under cross-examination, various contract figures upon this work, from which have been taken the figures

covering excavation, which we understand cover also the cost of backfilling.

MR. SEARLS: Mr. Stocker's testimony went solely to pipe within the city, Mr. Greene; that is understood, isn't it?

MR. GREENE: That is my understanding, yes.

This table (Table 10) is particularly interesting as showing the cost of pipe under these various contracts, and also that in one-half of the instances upon this work the contractor failed, notwithstanding that the prices were all of them, without exception, higher than Hazen's. Now, of course, it ought to be said in connection with that that the city work is more expensive than the country work.

Table 10.

(7575) Contract	#46	$1.00	per cubic yard		
	50	1.42½	"	"	
	48	1.30	"	"	
	44	.88	"	"	Contractor failed.
	44	1.40	"	"	Contractor finished the work.
	47	1.03	"	"	
	48	.80	"	"	Contractor failed.
	50	.95	"	"	Contractor failed.

In this connection Hazen's comparison of his pipe laying estimates in the city with the costs realized in the construction of the city high service fire pressure system is to be borne in mind (7461-65). While the city figures are not directly comparable with the country work it is interesting to note that Hazen's figures upon the labor costs involved in the construction of the pipe distribution system, range from 46%, on the pipes of 6-inch diameter, to 92% on the 20-inch, of the costs reported by the city in the construction of its high service fire protection system.

The difference in the excavation involved in the laying of the riveted pipe lines outside of the city covered by the Major Group Schedule, upon a total of 450,155 cubic yards, clearly lies between 71c per cubic yard and 85.8c per cubic yard, and amounts

to the approximate sum of $63,000. The difference is perhaps fully accounted for by the assumptions made by the several witnesses upon the number of hours constituting a day's work, the wage per day, and the labor performance per hour.

Assumptions as to Wages and Hours of Employment by Different Witnesses.

Hazen, who has had wide experience with all classes of labor, particularly in the eastern part of the United States, and to a very considerable extent all over the country, upon waterworks construction, investigated the labor conditions upon the Pacific Coast and in the neighborhood of San Francisco, analyzed the records of original cost of labor upon many of the Spring Valley Water Company's structures, and the records of the Southern Pacific Railroad, and concluded to use for his estimates the normal rate of $2.50 for a day of eight hours, as an average rate for the unskilled labor required to build the structures. (4389-95; 4488; 4563-5; 4568; 4575; 5089-92; 5100).

Lawrence, who has had many years of actual experience with labor in the construction and operating of the Spring Valley Water Company's plant, first upon a 10-hour and subsequently upon a 9 and an 8-hour per day basis, submitted in Pl. Exh. 99 the original cost and his estimate of the resolved (1913) costs, by substituting the 1913 labor prices and length of day for the prices actually paid at the time of construction; he also, figured labor upon the basis of an 8-hour day at $2.50 and stated that the difference between the work which a man will do in 8 hours and in 10 hours is in the direct ratio of 8 to 10 (6301), and that he did not think that labor today "considering the work we have performed heretofore * * * is as efficient as it was in 1898-1900." (6302).

Herrmann, who analyzed the physical data given in Lawrence's exhibit on flumes (Pl. Exh. 109), submitted in his evidence upon flumes in Pl. Exh. 108, a table upon "Flume Performance Rec-

ords, grouped according to length of days work." He concluded (6234) as follows, and based his figures upon a $2.50 daily wage for 8 hours work:—

"The ratio indicates that the rate of progress [not the actual progress] per hour is practically the same for an 8-hour day as for a 10-hour day, so that the direct resolution by percentage seems very fair; it seems the right thing to do; you can tell that from these figures."

Martin resolved his cost units upon earth work by assuming a 9-hour day at an increased rate ($2.75) based upon his broad experience in the employ of the Pacific Gas & Electric Company where 9 hours constituted a day's work. He stated from his general understanding and knowledge of working conditions, that higher rates are paid near the large cities where union rules are held to more closely than in the mountains. (7719-20).

Dorward, in his computations upon the reproduction cost figures for riveted pipes applied an increase in wages and a reduction in hours from the original cost basis to present day (1907-1913) basis in nearly direct ratio, and testified as follows: (4929)

"MR. McCUTCHEN: Q. * * * I am not speaking now about the difference in hours or the difference in wages, but I am speaking about the efficiency per hour?

"A. We do not consider we can get as much work out of a man per day as we did 10 years ago.

"Q. Can you hour for hour in your opinion get 80% of the work today that you could 10 years ago? A. 75, probably."

(4576) Metcalf made an investigation for the Boston Finance Commission of the Waterworks Department of the City of Boston, and found that "The City Engineer, Mr. Jackson, a very good man, had kept records for a number of years concerning what he called a typical piece of work, in order to get a line on that very thing [shorter hours and efficiency of work] and he found not only had there been an increase in the rate of wage

and decrease in the hours of labor, but there had also been a falling off in efficiency even under the shorter hours of day [employment]."

Ellis based his computations upon a 9-hour day at $2.50 (5233). He stated that he had experience during 1908 in the Crocker Tract in the northern part of San Mateo County, where labor was paid $2 a day for 9 hours; that he had the pick of men (6309); and that labor was paid on the same work $2.25 per day in 1907 (6310), though Lawrence stated (6306-8) that the company began paying $2.50 a day for 8 hours in 1902-3 and that good efficient labor he thought could not be obtained for $2.00 a day of 10 hours. During the years mentioned by Ellis (1907-08) the company was actually constructing the Merced branch of the San Andreas pipe line and paying there $2.50 per day of 8 hours. Reference to "P. 35" Pl. Exh. 99 shows that the actual cost in 1907 of the excavation and backfill upon the Merced branch of the San Andreas pipe line was $27,618, equivalent to (upon 26,756 cubic yards) $1.03 per cubic yard. This line was not situated upon the state highway and this figure ($1.03) is comparable with Hazen's reproduction cost estimate of 75c per cubic yard; Ellis' 65c; Dockweiler's 71c. Ellis, who assumes a 9-hour day in his computation from his experience as has been pointed out, stated in support of his assumption that the labor performance for a 10 and 8-hour day is not in the direct proportion of 10 to 8. (5233-4; 5257-59); and in support of his theory that the increase in cost from a 10-hour-$2.00-basis to an 8-hour-$2.50-basis, was not 60% but rather less than 20%, he cited what he said was similar work in San Francisco, done by the Independent Gas Company in 1901-02 compared with Pacific Gas & Electric work in 1912-13-14. (8239-42; 8288-94).

We should have no quarrel with the results obtained upon Ellis' theory if it were true that "if they work 9 hours at the same rate as 8 hours they will accomplish practically the same amount

of work as a man working 10 hours", (5233), but we submit that the evidence, of the other witnesses referred to, on this matter, bears out our contention that the "same rate as 8 hours" is not maintained, nor is the efficiency or rate-per-hour that was obtained years ago on the 10-hour basis now maintained upon the 8-hour basis. We submit that the comparison which Ellis made on the cost of the Independent Gas pipe work compared with the Pacific Gas & Electric pipe work, is not altogether a fair one as applied to the large gangs of men, and we think that your Honor appreciates this point from the question which you then asked, as well as from the statement made by Ellis (8240), that in the case of the Pacific Gas & Electric Company a better class of man was obtained and that because of the higher wages paid "a man has to be a good man to stay with them [Pacific Gas & Electric Company]."

It is to be noted further that Ellis in commenting upon Dorward's admission that in the case of skilled labor a difference of 20% would result from decreasing the hours of labor from 10 to 8, concedes that in the case of skilled laborers the pro-rated ratio holds much more nearly than it does for the unskilled labor. (5258-9).

We also call your Honor's attention to the testimony of Phillips, defendant's witness, upon brickwork construction, which indicates (7535) that because of the lack of men and absence of competition in the country, the city brickwork is done cheaper than work in the country.

It is to be borne in mind that this discussion upon hours and wages per day relates to work done in the country and not to the work done in the city where it is conceded, by defendant as well as plaintiff, that for common labor, 8 hours constitutes a day's work, and that $2.50 is the prevailing rate for unskilled labor.

Conclusions on Cost of Earth Work Excavation and Backfilling:

The evidence indicates that the price to be applied to the earthwork involved in the laying of the riveted pipe lines outside of the city clearly lies between 71c per cubic yard and 85.8c per cubic yard—(the difference between these figures, to wit, 14c per cubic yard applied to the total of 450,155 cubic yards amounting to the approximate sum of $63,000.) and we submit that the weight of evidence clearly indicates the fairness of Hazen's estimate, in view of the consensus of opinion upon the necessary common labor wage scale and hours of employment.

Accessories and Contingencies on Riveted Pipe Lines:

Finally, Hazen adds, in accordance with his usual practice based upon extensive experience, an allowance "for gates, air-valves, blow-offs, bands and lead joints, connections, concrete in trench, contractor's extras, and all ordinary accessories and contingencies" (4356), which he fixes for the conditions here prevailing at 10% of the sum of the previously discussed items, to wit, cost of the metal (plate), fabrication, excavation, laying, and backfilling, and in answer to a question as to whether he meant to give the impression that he always used 10%, he says, —"Not always, because there are some cases that call for other estimates, but for ordinary riveted pipe lines I do, because I have found that that is about what things have run" (4356), and he offered supporting evidence.

In passing, it is to be noted, however, (Pl. Exh. 98-j p.18) that Hazen states that "the above figures cover ordinary work only, and do not include allowance for auxiliary structures, and extra allowance for obstacles, separately listed in the schedule, nor the allowance for additional cost of laying those pipes that are in the city streets."

In support of his allowance Hazen gives detailed figures concerning the amount of the auxiliary and contingency item

expenses incurred upon the 12 miles of 32″ riveted pipe laid under his plans and direction in Springfield, Mass., which amounted to 10.3%; upon the first riveted pipe line laid by Mr. Clark at Portland, Ore., where these costs amounted to 13.3% of the main item; upon the second steel pipe line laid by Mr. Clark 11.4%; and cites the following other approximate, but comparable figures, 44″ pipe line in Portland, 5.1%; Washington, D. C., filtration plant, in excess of 10%; Brooklyn, N. Y., 3 miles of 48″ pipe on Clarkson and Woodruff Avenues, 24%; 4 miles of 66″ pipe laid by the Board of Water Supply through Brooklyn, 42%; another 2 miles of 66″ pipe laid by the same Board, 57%; Hazen stated further that while he has attempted to make similar comparisons for the Spring Valley pipe lines, he has been unable to get the necessary data to do this (4362-4364).

Dockweiler's and Dillman's allowances for miscellaneous structures upon the riveted pipe lines outside of the city have already been shown to amount to $248,061 and $206,901, respectively, as based upon the Major Group Schedule figures upon riveted pipe lines outside of the city submitted herein, but unfortunately these figures cannot be compared with Hazen's 10% allowance for the reason that a number of the items which they included in their basic fabrication costs, he included in his 10% allowance.

This is clearly one of those items which can only be determined by a man of large experience in such work, and who has had occasion constantly to make estimates of such pipe lines, which when compared with the final cost figures will serve to bring home to him, not only the hazard element in such work, but the large number of things which have to be done in the building of such a pipe line, which cannot be anticipated and scheduled in advance of construction, or indeed, after it, unless there be available such a voluminous, historic construction record as would in itself make difficult its comparison with other similar records.

Hazen's Cost of Substitute Steel Pipe:

Hazen also made an estimate of the cost of substituting steel pipe lines of equivalent carrying capacity for the wrought iron pipe lines actually in the system of the Spring Valley Water Company as a means of testing his estimated cost for the actual pipes. His exhibit (Pl. Exh. 98-k) and the discussion relating to it (4366-70), indicated a cost for steel pipe, slightly in excess of that estimated for the wrought iron pipe, giving further indication of the fairness of his basic estimate.

Conclusions Upon Gross Reproduction Cost Upon Riveted Pipe Outside of City:

Summarizing briefly the results of the foregoing analysis,—using Hazen's estimated cost of these structures as a standard of comparison,—we have shown as to,

1. Quality: Hazen was the only witness who gave detailed study of the character of the material of which the riveted pipe lines has been built, and he was, therefore, the only witness competent to estimate the allowance for these structures. He proved himself a master of the subject, thoroughly conversant with the actual local conditions.

2. Weight of Metal: Hazen's estimated weight of 33,754,000 pounds is substantiated by the estimates of defendants' witnesses, Dockweiler and Dorward. Defendants' witness Dillman made no serious independent investigation of the weight of these pipes.

3. Cost of Metal: Hazen's judgment of the fair cost of the metal in these riveted pipes, 4c per pound for the plates (largely wrought iron) f. o. b. San Francisco, was supported by defendants' witness Dockweiler, who got his information largely from the actual cost to the Spring Valley Water Company. The figure itself is proven.

4. Fabrication Costs: Hazen's cost of fabrication, 3.75c per pound, including therein the shop work, coating, transportation to the trench, assembling in the trench, and including the making of

bends, man-holes and other special work, was fully sustained by the estimates of defendants' only competent witness, Dorward, whose figures amounted to 3.85c per pound on a 35% shop profit, 3.41c per pound on a 15% shop profit, 3.63c per pound on a shop profit of 35% for half of the period and 15% for the other half of the period involved in these rate suits, excluding allowance, which he should have made, as it was not made elsewhere, for the overhead cost upon the materials furnished by the Spring Valley Water Company, which would have amounted to something less than 0.4c per pound.

5. Excavation: The fair cost of excavating and backfilling these riveted pipe lines, involving approximately 450,155 cubic yards, outside of the city, lies bettween 71c and 86c, the higher figure being Hazen's, the lower Ellis' and Dockweiler's. The total difference involved by these differences amounts to approximately $63,000, and we submit that greater weight should attach to Hazen's figures by reason of his large experience in the construction of riveted pipe lines.

THE MASTER: Plus 10% on the bends.

MR. GREENE: Yes, your Honor.

6. Accessories and Contingencies: Hazen's allowance of 10% on the sum of the foregoing items, to cover the auxiliary and contingent structures and work, which cannot be directly compared with Dockweiler's and Dillman's estimates, by reason of the different methods of estimating and segregating the items used by them, is well supported by comparable data and stands uncontroverted.

7. Comparative Cost of Steel Pipe Lines: Hazen finds that if the estimate of the reproduction cost of the riveted pipe lines outside of the city be based upon the substitution of steel pipes of equal carrying capacity for the existing wrought iron pipes, his figures would have to be somewhat increased.

8. Final Cost of the Riveted Pipe Lines Outside of the City: We submit that Hazen's estimate of the fair reproduction cost of

the riveted pipe lines outside of the city, shown in the Major Group analysis, and amounting to the total sum of $3,413,059, excluding overhead and interest-during-construction allowances, is well established and should be subjected to no deduction.

THE MASTER: Mr. Greene, I have a vague memory that at some point in his presentation Mr. Hazen took a round figure for this matter of riveted pipe, so that there was a question as to the difference between an adopted figure and a figure that would follow by exact estimation; does that conform to your memory?

MR. GREENE: It does on the question of fabrication, but I do not think he took a general figure for his final conclusions, except that when he adopted $20,000,000 for structures that was an approximate figure, and not an absolute addition.

THE MASTER: Your first remark may be what I had in mind. I remember that when he went through his detail it occurred to me that an addition which he made to his schedule by reason of recent contract prices was not fully justified. I remember he himself said he might very well have stayed by his schedule.

MR. GREENE: Yes.

THE MASTER: And, while I had some doubt about it, I think it was covered in my mind by an adopted figure later which may be that round figure of 3.75 for pipe fabrication that you refer to.

MR. GREENE: That is all I have in mind; there may be another to which the same thing would apply.

MR. SEARLS: I call your attention to page 18 of Exhibit 98-j, where he shows that his total estimated cost was $3,978,835, and the sum of his estimates in the schedule was some $3,951,531; so there was some difference, as you can see, between those two figures.

MR. GREENE: Of course, Mr. Searls, those figures are not comparable with the figure I have just referred to, because they include all the riveted pipe, both inside and outside of the city.

MR. SEARLS: No, I think not.

MR. GREENE: You will see that from the top of page 18, that it covers excavation both in and out of the city. Do you prefer to discuss that any further now, Mr. Searls, or shall I proceed?

MR. SEARLS: I just called your attention to it, I thought it might be of interest at this point.

2a. Earth Dams.

I now take up earth dams. In this connection I present Table 11. I think it is entirely clear. It shows the estimates on earth dams, as made by Hazen, Dockweiler and Dillman, and on the bottom part of the page the estimates upon flumes as made by the same witnesses, as well as by Herrmann, and again the combined estimates of both dams and flumes.

[Table inserted opposite]

THE MASTER: I thought Herrmann estimated on dams, too?

MR. GREENE: He gave some evidence, your honor, but not on all the items going into dams, so that we cannot at this point use his figures in this table; they will come in, however, at another time.

MR. SEARLS: I thought the flume item was covered by stipulation, except as to excavation?

MR. GREENE: Yes, except as to excavation, and that is the point of the difference here. We take up first the earthen dams, including in this classification the small stone dam on the lower Pilarcitos. On this subject, the witnesses for the plaintiff were Elliott, Hazen, Herrmann and Martin; for the defendant, Dillman, Dockweiler, Ellis and Noyes.

Experience of Witnesses:

Hazen has made designs for a number of dams, some of which have been built and some not, and he has been familiar with what has been done in dam construction throughout the country (4945-6). He stated that in the making of

2a Earth
Item 2, cov
convenience

2a and 7 **E**
Pilarcitos
Upper Cr

Pilarcitos S
pipes and
Extra lumb
Major Gr
from Flu
Stock-on-

Total Earth
2b **Flumes:**
principall
Extra lumb
Major G
from Flu
Stock-on-

Total Flum
Sum of 2a a
These total
parison M
2 Earthen I
7 Crystal S

*Dillman
Flume 6th

Table 11.

2a Earth Dams (including "Stone" Dam and Upper Crystal Springs Dam). **Summarized Comparison in Major Groups,** Item 2, covered the entry "Earthen Dams and Flumes," and Item 7, the "Upper Crystal Springs Dam." These, for convenience in arguing, are now separated into the following subject groups.

	Hazen	Herrmann	Dockweiler	Dillman
2a and 7 **Earthen Dams:**				
Pilarcitos, San Andreas, Clay Dam, San Mateo Creek....	$909,040	.....	$523,827	$576,758
Upper Crystal Springs Dam	261,300	.....	184,283	171,143
	$1,170,340	.....	$708,110	$747,901
Pilarcitos Stone Dam, Concrete Dam in San Mateo Creek, waste pipes and concrete flumes, etc	38,410	.....	22,089	21,628
Extra lumber piled along flume lines, included in Inventory and in Major Group "Earthen Dams and Flumes," but to be excluded from Flumes, as the items are covered in the agreed Inventory of Stock-on-hand	1,391	.....	.....	930*
Total Earthen Dams Group	$1,210,141		$730,199	$770,459
2b **Flumes:** Excavation, Lumber in place and Miscellaneous items, principally clearing and tarring and caulking	$303,020	$311,068	$235,520	$236,710
Extra lumber piled along flume lines, included in Inventory and in Major Group "Earthen Dams and Flumes," but to be excluded from Flumes, as the items are covered in the agreed Inventory of Stock-on-Hand	725	809	.....	30*
Total Flume Group	$303,745	$311,877	$235,520	$236,740
Sum of 2a and 7 Earthen Dams and 2b Flumes	$1,513,886	.....	$965,729	$1,007,199
These totals are comparable with totals shown on Summarized Comparison Major Group Schedule, (Table 1) viz:				
2 Earthen Dams and Flumes	$1,252,586	.....	$781,446	$836,056
7 Crystal Springs Upper Dam	261,300	.....	184,283	171,143
	$1,513,886	.....	$965,729	$1,007,199

*Dillman does not specify extra lumber along Sunol Aqueduct, except structure 6, p. 76, nor along Pilarcitos Aqueduct, Flume 6th Section (p. 5 Structure 30).

his estimates he was guided particularly by his recent experience in building the Borden Brook dam for the Springfield Water Works in Massachusetts, a dam of about the same height as the Pilarcitos and San Andreas, though not quite so long as either of them; and by another dam, not quite so high. Incidentally, he mentions that he has, of course, done earthwork in a great many places such as Albany, Springfield, Yonkers, Poughkeepsie, Washington, and elsewhere.

He examined the structures themselves most carefully, was familiar with such construction records as Lawrence and the company possessed, had interviewed Mr. Schussler, Lawrence, Ebright and others who had had to do with the original construction, and had consulted particularly Chief Engineer Hood of the Southern Pacific Railroad, with regard to labor prices paid by this company in this vicinity. Incidentally, he referred to the labor union (5089-91) problem as being of significance (5097-9).

Herrmann assisted in the work upon the Williams dam (concrete) for the San Jose Water Company (4959), had had experience upon heavy levee construction on the Colorado River, and (4960) built three earthen dams across the New Alamo and Alamo Mocho Rivers. With Mulholland's aid he designed the Calaveras dam and had charge (4960) of its construction between 1910-14; had charge of the work of the Modesto Irrigation District, including the making of four or five (4961) heavy fills by hydraulic methods; obtained information from Martin concerning the costs of various embankments built by the Pacific Gas & Electric Co. (4969, 4970), with which he was familiar (5126, 5141); and had been furnished with the costs of the Los Angeles dams by Mulholland (4971-2; 5112-16; 5155).

Elliott, engineer of the Spring Valley Water Company—who testified here only on steam shovel performance,—stated that aside from his general engineering familiarity (5381-83) his personal experience with steam shovel work was limited to that upon Calaveras dam from 1914 to the present time, and to observations

which he had made from time to time upon Mulholland's work at Los Angeles upon the San Fernando dam, and the upper and lower Franklin dams. Elliott gave Calaveras steam shovel operating costs, and controverted and corrected Dockweiler's statement concerning the performance of the steam shovels upon Mulholland's work in Los Angeles, and compared the conditions prevailing on the San Fernando, Los Angeles and Calaveras dams with those encountered upon the Pilarcitos, the last of which he thought much more difficult (5397).

James Martin, for the plaintiff, stated that he had been in the employ of the Pacific Gas & Electric Company for the last fourteen years, during which entire period he had been on active construction work, as he had, in fact, for different employers for the past twenty-three years. Since 1905 he had acted as foreman, general foreman, and finally superintendent, in charge of different kinds of construction work, involving largely tunneling, masonry and earth work upon jobs of large magnitude where he had forces of men under his direction (7709, 7711, 7688, 7693). While not an engineer by training, he was essentially a construction man of large practical experience and had kept costs for many years.

Dillman's experience with dams was limited substantially to the ditch work which he has done on irrigation plants. He says (5011) that he had never built a high earth dam. He saw the construction of the last lift of the San Leandro dam, but had no data concerning its cost, and did not think it would be comparable if he had, because that work was carried on in a very expensive way. Upon this subject we shall have occasion to comment later, because it was clear that Dillman had in mind the construction of very different structures from those which were actually built by Mr. Schussler for the Spring Valley Water Company. The San Leandro work was, Dillman said, in charge of an extremely careful man, Orestes Pierce. Dillman had a vague recollection of having bid 30c per cubic yard (5011) on the Wild Horse Valley dam of the City of Vallejo, in 1894. Dillman had seen the La

Mesa dam in San Diego County, and the Woodbridge dam, which they attempted to tighten, and which he examined after its failure, in order to make report to the New England Trust Company. He also saw the Portland, Oregon, Water Works dams in visiting those works. He stated that he had had experience in the building of levees, ditches, railroads and general construction work, and in handling steam shovels and scrapers, and other equipment (5013) necessary to construct these dams. He had the agreed inventory of the Spring Valley Water Company property and inspected the dams a few times. The borrow pits were evident on the outside of the reservoir (5014).

Dockweiler's experience upon dams was limited to their inspection (5029) and to reading about them. He said that he had studied the history of the existing dams, read over all the reports that he could get bearing upon their construction and design, and the testimony given regarding them by the officials of the company before the board of supervisors, and Mr. Schussler's testimony in the last trial. He read the testimony in the Pacific Gas & Electric Company's rate case before the Railroad Commission. He said that he was familiar with the cost of the earthwork construction and the building of dams, as instanced by Mulholland's work at Los Angeles, the Vallejo and San Leandro dams and the Central reservoir; the three latter built in 1909, 1874 and 1910 respectively.

It is to be noted and regretted that the greater part of Dockweiler's figures upon dam construction were not derived from the final cost sheets of the work, but from observations (with stop watch in hand) extending over a period of but a few hours or a few days upon the work done momentarily in certain lines of work, a very misleading and dangerous method of estimating final costs, as has already been noted herein.

Dockweiler has never built any dams, unless by a stretch of the imagination the three-foot dike around the St. Vincent's Orphanage at San Rafael could be characterized as such. His estimate was purely academic and synthetically derived.

A. P. Noyes, whose testimony was limited to the cost of the Wild Horse Valley Reservoir No. 2, or the Vallejo dam, resident of San Francisco, who has worked in the civil engineering field for twenty years past, was City Engineer of Vallejo in the year 1907-8. He designed and prepared the specifications for the Vallejo dam and supervised its construction during his incumbency in the City Engineer's office.

Major Differences in Estimates:

The estimates upon earth dams (including the small "stone dam" on the lower Pilarcitos) naturally grouped themselves into the following classes of items—excavation, puddle trench, puddle fill, embankment, auxiliary structures and miscellaneous, as will be seen by the following analyses of the Major Group Schedule earthen dam and flume items heretofore referred to. I will now present these tables, 12, 13 and 14; the figures that are shown

[Tables inserted opposite]

on these three exhibits are simply the detail of the estimates, and give in convenient form the amounts estimated by the different engineers for the items in gross and also in detail; they will be of use when we come to the discussion of the different items.

The radical differences in estimate are limited to two items, the cost of the "Puddle Fill" and "Embankment". We shall first refer to the other items, and then take up the two just mentioned.

Excavation for Earth Dams:

While the prices vary considerably, the amounts involved, by the differences in estimate, is not large. Hazen estimates the total cost at $37,965; Herrmann, $41,109; Martin, $37,373; Dockweiler, $26,675; Dillman, $21,267, excluding the item of the San Mateo Clay Dam, or including Dockweiler's allowance therefor ($539), a total of approximately $21,800.

Table 12

COMPARISON REPRODUCTION COST ESTIMATES UPON Earthen Dams and Flumes

Excl. Overhead and Interest-during-Construction as of Dec. 31, 1913.

Major Group Schedule, Earthen Dams and Flumes	Hazen	Herrmann	Dockweiler	Dillman
Inv. Pg. 1 6 Pilarcitos Dam Feeder Flumes and Aqueduct	$407,436	$426,878	$241,018	$273,411
7 12 Stone Dam Aqueduct	242,065	232,255†	184,293	175,529
14 15 San Andreas Dam	521,439	541,653†	301,360	328,820
76 77 Sunol Aqueduct	82,451	87,522	55,486	58,952
Sub-total	$1,253,391	$1,288,308	$782,157	$836,712
Deduct buildings included in Joint Exhibit covering buildings:				
(a) Inventory p. 3; Str. 16; Superstructure	473	450	349	349
(b) " 4; " 22; Tool houses	70	75	104	50
(c) " 5; " 32; Shed	62	50	52	42
(d) " 14; " 3; Superstructure	200	250	215	215
Sub-total items (a), (b), (c) and (d)	805	825	720	656
Leaving the totals of Earthen Dams and Flumes as shown Summarized Comparison "Major Groups," table 1	$1,252,586	$1,287,583 excl. str. shown below†	$781,437	$836,056
Upper Crystal Springs Dam, Major Groups	261,300	omitted	184,283	171,143
Total "Earth Dams and Flumes"	$1,513,886	.....	$965,720	$1,007,199

Note:†—Excl. Structures, viz.:

Pg.	Str. No.	Valued by Hazen at
10	27	$3,100
10	32	7,871
15	4	26,460
		$37,431

The above totals "Earth Dams and Flumes" are segregated in accompanying tables, as follows:

Earthen Dams:				
(1) Earth work only incl. clearing and riprap (i. e., excavation, trenching, puddle fill, embankment, clearing riprap and miscellaneous small structures). See table 13	$1,008,580	.....	$584,547	$614,310
(2) Miscellaneous Structures, incl. under "Earthen Dams" in Major group schedule (wasteway, outlet tunnels, boom, gage board, etc.)				
Pilarcitos Dam (Table 14)	56,362	*	39,044	36,777
San Andreas Dam (Table 14)	51,198	**	44,489	49,372
Upper Crystal Spgs. Dam (Table 14)	54,200	.....	40,030	47,442
(3) Pilarcitos Stone Dam, Concrete Dam in San Mateo Creek, waste pipes and concrete flumes, etc	38,410	.....	22,089	21,628
(4) Extra lumber piled along flumes in group (3)	1,391	.....	.....	930
Total "Earthen Dams" incl. Stone Dam, etc. Items (1), (2), (3) & (4)	$1,210,141	.....	$730,199	$770,459
* Herrmann's figure	.....	$53,385		
** Herrmann's figure	.....	27,900 omitting Str. 4, p. 15, valued by Hazen at $26,460,		

Flumes *

The following data refers to those flumes which were discussed in evidence in Major Group Schedule "Earthen Dams and Flumes" and covers the data submitted upon which agreement was reached between the parties concerning the value of lumber in place.

	Hazen	Herrmann	Dockweiler	Dillman	Joint Ex.
(a) **Lumber** 1538.5 B. M. Clear Redwood; 2148.8 " Rough Redwood; 206.1 " Rough Oregon Pine					
Total: 3893.4 "	$197,522	$194,228	$176,006	$175,203**	$183,000
Average figure per 1,000 f. b. m. all lumber	$50.80	$49.90	$45.20	$45.00	$47.00
(b) **Excavation**					
59,200 cu. yds. Earth @ $0 40	23,700	$.50 29,600	$.30 17,753	$.25 14,800	
24,932 " Loose rock @ 1 00	24,932	1.20 29,918	.50 12,488	.50 12,488	
20,859 " Hard Rock @ 2.00	41,718	2.00 41,718	.75 15,645	1.00 20,859	
Sub-total	$90,350	$101,236	$45,886	***$48,147	
(c) Miscellaneous Items, principally for clearing and caulking and tarring	15,148	15,604	13,628	13,360	
(d) Extra lumber piled along flumes to be deducted from "Flumes" as it is included in the agreed amount for "Stock on Hand"	725	809	.....	30	
Totals (a), (b), (c) and (d)	$303,745	$311,877	$235,520	$236,740	

*In the comparisons made under "Flumes" which were used as a basis for the agreement upon the cost of lumber in place, the following flumes were omitted:

Page 16, Str. 3	Included in "Major Group" Schedule under "Miscellaneous amounts not covered by Major Groups discussed in evidence or not covered by Joint Exhibits."
16 " 4	
18 " 8	
35 " 2	
35 " 3	
79 " 5, 6 and 7	Niles Aq. Flume incl. in "Niles Aq." Major Group.
209 " 16 and 17	Included in Major Group "Lake Merced Reservoir Drainage System and Supply and Discharge Pipes and Pumps."

**Taken at Dillman's figure of $45 per M. for lumber in place.
***Dillman's amts. were obtained by applying units given him (p. 6172) to yardage shown in inventory.

Table 13

COMPARISON REPRODUCTION COST ESTIMATES UPON EARTHEN DAMS

Excluding Overhead and Interest-during-Construction Expenses as of Dec. 31, 1913.

Pg.	Str.	Name of Dam	Quantity	Hazen Unit	Hazen Amount	Herrmann Unit	Herrmann Amount	Dockweiler Unit	Dockweiler Amount	Dillman Unit	Dillman Amount
EXCAVATION											
1	1	Pilarcitos Dam	27,127 cu. yds.	$0.50	$13,564	$0 47	$12,750	$0.28	$ 7,596	$0 25	$ 6,782
12	36	Clay Dam, San Mateo	2,450 "	0 50	1,225	0.46	1,127	0 22	539	.....	omitted
14	1	San Andreas Dam	57,940 "	0.40	23,176	0.47	27,232	0.32	18,540	0.25	14,485
32	1	Upper Crystal Springs	.....	.....	.....	.....	omitted	.....	.....	.....	.....
Sub-total (excl. Upper Cry. Spgs. Dam)			.....	.....	$37,965	.....	$41,109	.....	$26,675	.....	$21,267x
" (incl. " " ")			.....	.....	$37,965	.....	.....	.....	$26,675	.....	$21,267x
PUDDLE TRENCH											
1	1	Pilarcitos Dam	6,400 cu. yds.	$2.50	$16,000	$3.15	$20,160	$1.67	$10,688	$1.00	$13,320
12	36	Clay Dam, San Mateo	471 "	2.00	942	2 50	1,178	1.00	471	.....	omitted
14	1	San Andreas Dam	13,528 "	2.50	33,820	3.15	42,613	1.45	19,616	0 50	12,164
32	1	Upper Crystal Springs	15,800 "	2.00	31,600	.....	omitted	2.00	31,600	0 50	7,900
Sub-total (excl. Upper Cry. Spgs. Dam)			.....	.....	$50,762	.....	$63,951	.....	$30,775	.....	$25,484x
" (incl. " " " ")			.....	.....	$82,362	.....	.....	.....	$62,375	.....	$33,384x
PUDDLE (Fill)											
1	1	Pilarcitos Dam	34,302 cu. yds.	$1.50	$51,453	$1.52	$52,140	$0.72	$24,697	$1.00	$34,302
12	36	Clay Dam, San Mateo	1,200 "	1.50	1,800	1.50	1,800	0.48	576	.....	omitted
14	1	San Andreas Dam	48,056 "	1.50	72,084	1.52	73,045	0.75	36,042	1.00	48,056
32	1	Upper Crystal Springs	24,200 "	1.50	36,300	.....	omitted	0 80	19,360	1.00	24,200
Sub-total (excl. Upper Cry. Spgs. Dam)			.....	.....	$125,337	.....	$126,985	.....	$61,315	.....	$82,358x
" (incl. " " " ")			.....	.....	$161,637	.....	.....	.....	$80,675	.....	$106,558x
EMBANKMENT											
1	1	Pilarcitos Dam	336,900 cu. yds.	$0 65	$218,985	$0.70	$235,900	$0.36	$121,284	$0 40	$134,760
12	36	Clay Dam, San Mateo	7,000 "	0 65	4,550	0.70	4,900	0 40	2,800	.....	omitted
14	1	San Andreas Dam	469,526 "	0 65	305,192	0.70	328,668	0.34	159,639	0 40	187,810
32	1	Upper Crystal Springs	195,940 "	0.60	117,564	.....	omitted	0 39	76,417	0.40	78,376
Sub-total (excl. Upper Cry. Spgs. Dam)			.....	.....	$528,727	.....	$569,468	.....	$283,723	.....	$322,570x
" (incl. " " " ")			.....	.....	$646,291	.....	.....	.....	$360,140	.....	$400,946x
MISCELLANEOUS ITEMS											
1	1	Pilarcitos Dam	.....	.....	$19,700	.....	$20,820	.....	$12,710	.....	$16,103
12	36	Clay Dam, San Mateo	.....	.....	4,005	.....	4,366	.....	2,924	.....	.....
14	1	San Andreas Dam	.....	.....	34,984	.....	41,393	.....	22,172	.....	15,948
32	1	Upper Crystal Springs	.....	.....	21,636	.....	omitted	.....	16,876	.....	13,225
Sub-total (excl. Upper Cry. Spgs. Dam)			.....	.....	$58,689	.....	$66,579	.....	$37,806	.....	$32,051x
" (incl. " " " ")			.....	.....	$80,325	.....	.....	.....	$54,682	.....	$45,276x
Total Reprod. Cost Est. excl. Upper Cry. Spgs. Dam			.....	.....	$801,480	.....	$868,092	.....	$440,294	.....	$490,609a
Total Reprod. Cost Est. incl. Upper Cry. Spgs. Dam			.....	.....	1,008,580	.....	.....	.....	584,547	.....	614,310b

xDetails Clay Dam San Mateo Creek excluded from total.
a and b—Each include Dillman's estimate ($6,879) for Clay Dam, San Mateo Creek.

Table 14

COMPARISON REPRODUCTION COST ESTIMATE AUXILIARY STRUCTURES

included in Earthern Dams "Major Group" Schedule.

Pg.	Str.		Hazen	Herrmann	Dockweiler	Dillman
		Pilarcitos Dam:				
1	2	Brick Waste-way	$11,931	$12,250	$8,153	$7,822
1	3	Outlet Tunnel	8,483	9,100	7,368	6,209
1	5	Brick Flume	927	1,041	736	1,106
1	6	Gage Board and Boom	621	350	390	463
2	7	Inspection Tunnel	5,900	1,885	2,680	909
2	13	Ornamental Concrete	392	400	Omitted	386
3	14	Lower Outlet Tunnel	7,861	6,851	4,509	5,135
3	15	Drain Pipe	708	1,000	1,750	2,323
3	16	Forebay and Gate House	18,861	19,838	13,029	12,022
4	24	Experimental Apparatus	642	640	409	382
6	33	Brass Weirs	36	30	20	20
			$56,362	$53,385	$39,044	$36,777
		San Andreas Dam:				
14	2	Dam at old Waste-way	13,632	15,741	7,918	7,479
14	3	Waste Gate-tower and Chamber	9,994	10,988	8,070	12,619
15	4	Waste Tunnel	26,460	Omitted	28,101	28,459
15	6	Log Boom	694	671	245	459
15	7	Gage Board	60	50	41	31
15	8	Ornamental Concrete	257	350	Omitted	262
15	9	Feed Pipe	101	100	114	63
			$51,198	$27,900	$44,489	$49,372
		Crystal Spgs. Dam (Upper):				
32	2	Gate House	3,551	.....	2,411	2,006
32	3	Waste Tunnel	34,405	.....	23,795	30,423
32	4	Concrete Culvert	16,244	.....	13,824	15,013
			$54,200	.....	$40,030	$47,442
		Stone Dam Aqueduct:				
7	1	Pilarcitos Stone Dam	12,268	12,579	7,711	6,948
7	2	Concrete Dams	81	50	49	39
8	14	Extra Lumber	1,391	1,483	Omitted	930
8	15	Concrete Dam	13,584	10,963	7,752	7,232
10	27	Waste Pipe	3,100	Omitted	1,555	1,879
10	30	Concrete Culvert	742	718	487	480
10	31	Concrete Flume	764	746	503	502
10	32	Tunnel #3	7,871	Omitted	4,032	4,548
Total Excl. Extra Lumber			$38,410	.....	.....	$21,628
Total Incl. Extra Lumber (p. 8; Str. 14)			39,801	.....	$22,089	22,558

Herrmann, who, as chief engineer of the water company has had great familiarity with the property and who has had greater experience than Dillmann in such work and, necessarily, than Dockweiler, who has had none, estimated prices of 46c and 47c per cubic yard; Hazen, who has had the widest range and perhaps the most experience in such work, 50c on the Pilarcitos and 40c on the San Andreas dams; James Martin, an experienced construction man, 48c and 40c; Dockweiler, without experience, 22c and 32c; Dillman, 25; Ellis, the city's most experienced witness, 35c.

Puddle Trench Excavation:

Hazen, $82,362; Herrmann, $95,500 (including Hazen's and Dockweiler's allowance upon the upper Crystal Springs dam, which Herrmann did not estimate); Dockweiler, $62,375; Dillman's first estimate, $21,064 (revised by us to $41,131 on the basis of his admissions under cross-examination) (5156-57; 5166), cannot be compared with the other estimates as he valued the upper Crystal Springs dam on a purely arbitrary basis, disregarding the actual character of the construction,—instead of treating it as did Hazen and Dockweiler by fairly estimating its reproduction as built of existing materials, and then depreciating it heavily, by reason of the change in the character of its use, since the latter use would have permitted its construction, as a simple embankment for roadway, at a much lower cost. Moreover, Dillman excluded allowance for the necessary sheeting incident to the excavation of the "Puddle Trench" in the Pilarcitos and San Andreas dams, as was made clear in his cross-examination (5166), stating that he did not know the depth of the trench in which the puddle core was below the surface, until it came out in evidence, nor did he think it important as his estimates in all these particulars were not especially exact, being better as a whole than in part. Under cross-examination he (5156) admitted that he would increase his Pilarcitos figures by the sum

of $6920 and San Andreas $5400 to cover the necessary lagging,—raising his estimated costs from $1 and 50c to $2.08 and 90c per cubic yard, respectively. If these revised figures be applied to Dillman's estimate and his Crystal Springs upper dam rate be increased from his 50c to his 90c per cubic yard, his total estimate upon the "Puddle Trench Excavation" would be increased from $21,064 to $41,131.

Herrmann gave important comparative figures (4980-4).

The difference between the company's witnesses and the city's only witness, who covered this item, is $20,000. In measuring this difference, the relative experience of the witnesses Hazen and Dockweiler must govern.

Auxiliary structures, as here segregated, to conform to the Major Group Schedule, comprise the groups of items as shown on Table 15.

Table 15

Auxiliary Structures at	Hazen	Herrmann	Dockweiler	Dillman
Pilarcitos Dam.....	$56,362	$53,385	$39,044	$36,777
San Andreas Dam....	51,198	Incomplete	44,489	49,372
Upper Crystal Springs Dam.....	54,200	.....	40,030	47,442
Stone Dam.....	39,801x	26,539	22,089	22,558xx
	$201,561x	Incomplete	$145,652	$156,149xx

xIncluding $1,391 for extra lumber, included in "stock on hand", total excluding this item..... $200,170

xxIncluding $930 for extra lumber included in "stock on hand," total excluding this item..... $155,219

Reference to Table 14, showing the segregation of items in the groups cited above, indicates that the major items of difference in these estimates is to be accounted for by the brickwork in the waste-way, forebay, and gate house at the first two dams; by the concrete culvert at the upper Crystal Springs dam; by the stone-work and concrete at the stone dam on the lower Pilarcitos; and

by the Tunnel No. 3, through which the flume passes at the San Andreas dam.

As these masonry items will be fully discussed under the Crystal Springs dam and brickwork, it is unnecessary to dwell upon them at this point beyond stating that in the later discussion it clearly appears that Dockweiler's and Dillman's estimates upon these structures were inadequate and unfair to the company.

Hazen's estimates upon these structures are consistent with his treatment of the more important masonry structures discussed later herein; and we submit that his figures, supported as they are subsequently shown to be, should prevail.

Miscellaneous Items:

Hazen, $80,325; Herrmann, $88,215 (obtained by adding to his $66,579 Hazen's estimate upon the upper Crystal Springs dam, upon which Herrmann did not estimate $21,636); Dockweiler, $54,682; Dillman, $60,520 (obtained by adding to Dillman's $57,596 Dockweiler's estimate upon the San Mateo clay dam $2,924, upon which Dillman did not estimate). The difference between the plaintiff's and defendants' estimate is due principally to the item of riprapping, upon which we have the following comparison. I present Table 16.

Table 16.

	Sq. Feet	Hazen	Herrmann	Dockweiler	Dillman
Pilarcitos Dam.....	86,000	10c $8,600	10c $8,600	6c $5,160	6c $5,160
San Andreas Dam..	152,200	10c 15,220	15c 22,830	6c 9,132	6c 9,132
Upper C. S. Dam...	119,000	10c 11,900	not estimated	6c 7,140	6c 7,140
		$35,720		$21,432	$21,438

Hazen made particular examination of the riprapping and had Lawrence dig holes to determine its thickness (4952, 5455), finally basing his estimate upon a price of 10c per square foot. Herrmann allowed 10c and 15c per square foot respectively upon the Pilarcitos and San Andreas work (4987). In substantiation of his figures he quoted prices paid upon his Modesto work, varying from 6c to 16c,

the weighted average (5353, 5360) being 10.2c, the 5c items covering the use of local hardpan (5354). In comment upon these prices he stated that the material was more available upon his Modesto work than it was upon the Pilarcitos and (5359) San Andreas dams.

Dockweiler here again resorted to synthetic costs (5058).

Noyes stated that upon the Vallejo dam, the contract price paid for riprapping was 5.5c per square foot and his estimate of the cost to the contractor 3.9c, but the far greater availability of the material upon the Vallejo dam, as compared with the Pilarcitos (5356) and San Andreas dams was pointedly discussed by Herrmann.

We submit that the judgment of plaintiff's engineers upon this "Miscellaneous" item was well sustained by the evidence, and that Hazen's figures at least ($80,325) should govern.

We turn now to the consideration of the two items principally responsible for the difference in estimate of plaintiff's and defendants' engineers upon the cost of earth dams, to wit, the "Puddle Fill" or Water-Proof Clay Core and the rest of the "Embankment". It is evident that these two items are more or less intimately interrelated.

Puddle Fill:

Hazen, $161,637; Herrmann, $163,285 (obtained by adding to Herrmann's $126,985 Hazen's estimated cost of upper Crystal Springs dam upon which Herrmann did not estimate); Dockweiler, $80,675; Dillman, $107,134 (found by adding to Dillman's $106,558 Dockweiler's estimate of $576 upon the San Mateo clay upon which Dillman did not estimate).

Hazen speaks with particular feeling and full knowledge concerning the art of puddling and its use in water-proofing structures (4953).

"Puddling is, unfortunately, getting to be a lost art. The engineers of the former generation attached a great deal of

importance to puddling. Fortunately, I had experience when I was a beginner with a man who thoroughly understood puddling. I have placed a great deal of puddle in my work. It has been displaced in recent years very largely by concrete in reinforced concrete structures which have been used in place of puddle. I think, generally speaking, it has been an unfortunate change; there have been a great many reservoirs that have been water proofed by concrete that leak and that leak so as to make them unsatisfactory; they might have been tight if puddle had been used. The cost of making puddle varies a great deal with the materials that are available, and with the methods that are used. I have known puddle to be placed at a cost of $5 or $6 per cubic yard. In my own experience I think $1.50 has been about a representative normal figure. That is what I used in this case. I recognize that there is some uncertainty as to just what was done in this case, and as to just what it would cost to reproduce it. I think this figure is a fair estimate based on such information as I could get. The dams, I think, are entirely tight, which has some bearing upon the efficiency of the methods that were used."

Moreover, he does this after conference with Mr. Schussler, Lawrence and Ebright as to the actual care which was taken in the construction of the existing dams.

Herrmann stated that he was not experienced in the use of "puddle", but cited his experience on the Modesto (4984) Irrigation District work where he estimated that the cost of puddling the walls of the canal would be approximately $1.60 per cubic yard, and the puddled core of the Haiwee dam which cost $3.44 per cubic yard (5116).

(5024) Dillman admits "There can be all sorts of money spent on making puddle", and after describing the methods of manipulation (5025) which seemed to him adequate, states, "The real dam here is this core wall; the rest of the structure is to support and protect that core wall; the riprap is to protect that protection.

The reason that I have estimated a low price compared to some of the other estimates for embankment, is because it is not necessary to make the embankment impervious. If the embankment is made impervious by putting up in small, thin layers and rolling, there is no need of puddle. If the puddle is impervious and is the dam—which I take it to be in this case—there is no need for that extensive work on the slopes. I have assumed that the specifications were reasonable. * * * *.''

Yet it is to be noted that he allows the very low price of (5024) $1.00 per cubic yard for this puddle fill upon which he proposes to rely for the tightness of his embankment,—we say ''his'' advisedly for it is clear that Dillman did not figure on the construction of a dam of the character of those actually built by Mr. Schussler.

Dockweiler had had no personal experience in the making or use of clay puddle, and cited limited data only as to certain of Mulholland's dams, which were not in fact made waterproof by the use of such puddle as was under discussion, but by hydraulic fill, as was clearly brought out by Herrmann. The hydraulic fill can, of course, be placed at a much lower price when suitable material is available.

We submit, therefore, that the estimate of Hazen ($161,637), who was experienced in such work, and had fixed his estimate on the basis of the existing dams and what he could find out about them, is entitled to the greatest consideration.

Embankment: Hazen, $646,291; Herrmann (with Hazen's allowance for upper Crystal Springs dam upon which he did not figure), $687,032; Martin (based upon his unit figures), $696,000; Dockweiler, $360,140; Dillman (with Dockweiler's allowance upon the clay dam omitted by Dillman), $403,746; Ellis (based upon his unit figure of 50c per cubic yard), $505,000.

I will present your Honor with a table showing certain figures in detail:

Table 17.

Hazen estimated for Pilarcitos and San Andreas and Clay dams per cubic yard 65c
For the Upper Crystal Springs Dam 60c
and he cited as supporting evidence his recently built Borden Brook Dam 69c
with a total cost of all items thereon predicated upon the embankment yardage, per cubic yard 94c
and upon another dam recently built by him, per cu. yd ... 86c

Herrmann estimated upon alternate bases of use of scrapers, wagons, and steam shovel, and of scrapers and wagons only per cubic yard 70c
and stated that he had the following figures before him (per cubic yard) in estimating these costs,—

Drum Forebay	74½c
Lake Valley Dam	80c
Lake Arthur Dam	76c
Steam shovel work at Calaveras without segregation, sprinkling or rolling	53½c
Imperial Valley (Alamo) Dam with $2 wages for 10 hours and no puddle material available for core	48c
Dry Canyon, North Haiwee and South Haiwee Dams	37½c to 41c
Modesto hydraulic fills of pervious sand	23c to 25½c
Morton Fill, Modesto, machine work only	60c
Morton Fill, Modesto, total with part machine, part hydraulic fill	39c
Dallas-Warner Reservoir, Modesto	45c

On this structure he says he is now spending about as much more as the original cost to make it tight.

James Martin estimated upon the first 58,000 cubic yards removed in stripping (per cubic yard) 52c
and upon the balance 70c
He stated that these figures were based upon his past experience (which was substantial in amount) in the employ of the Pacific Gas & Electric Co.

Dockweiler estimated (average) per cubic yard 36c

Dillman per cubic yard 40c

Ellis, for the Defendant, basing his estimate upon his experience on the Tabeaud Dam, where the embankment work he says cost, per cubic yard 40c
estimates the cost of these dams at per cubic yard 50c
an advance of 39% over Dockweiler's figures and 25% over Dillman's.

Methods of Making Embankment: Basis of Estimate:

Hazen assumed that these embankments would be built by steam shovel, so far as suitable face could be obtained (4949, 5097) but inclined to the view that most of the material would be (4950, 5082) handled by scraper and wagon; that the dams were and should be (4950, 4953) built of selected material with thoroughly puddled core; that (4958) hydraulic filling methods were not practicable here; that the (5094) materials were and should be properly assorted, sprinkled and that provision would have to be made for carrying and controlling the ordinary flow, and for carrying the flood flow, across (5074) the embankment; and contends that a well built earthen dam such (4953) as these would be practically tight; and would not settle (5177, 5184) appreciably.

Herrmann estimated along similar lines, making independent estimate upon the basis of scraper and wagon on the one hand, and steam shovel, scraper and wagon work on the other. He called attention to the need of careful selection and segregation of materials, sprinkling, rolling, etc., referred to by Mr. Hazen. He was doubtful about the advantage of the use of steam shovels on account of the lack of borrow pits, the skin work necessary, due to the denuding of the hills, the effect (4974, 4980 et seq; 5154) of the high rainfall on the coast and the inevitable delays which he says amounts to between 25% and 35% even during fair weather, flatly controverting Dockweiler's inexperienced (5147) estimate of 10% allowance for delays in steam shovel work.

James Martin, skilled in such construction, says that (7696) he did not figure upon using a steam shovel, because he believes the steam shovel method for building embankment is not the best method and that the saving is comparatively small at the expense (7697) of the quality of the work. He objects to the use of the steam shovel on the grounds that for economical operation a full stroke of the dipper is necessary and is not available at these sites; that proper segregation of the materials and moisture are

impossible; that large rocks in the material seriously increase (7696-97) the cost of handling earth work; and that rolling becomes much (7717) more difficult. He bases his figures on well selected, carefully rolled and compacted materials with puddled core, upon the cost of which he did not estimate because his experience in placing puddle was limited, and upon the rolling of the inner one-half of the embankment, believing that this was the way the work was and should be done; and significantly adding, "All the work I have done required such compacting."

(7698) He states that his estimates cover the direct costs only without profit; no overhead, engineering, superintendence, contingencies; no depreciation, nor allowance for losses of tools and equipment, temporary roads and lines, nor any charges of an overhead nature. He has included only the field work and direct field costs and the labor charges up to and including the foreman, but not his own salary as superintendent or responsible head of the work.

Elliott confirms Herrmann's and Hazen's (5384) figures upon the steam shovel work at Calaveras dam (54c without rolling) without careful segregation of the materials or rolling and gives evidence concerning the performance of Mulholland's steam shovel at Los Angeles covering a far longer period of observation than, and flatly contradictory to, the conclusions of cost of the Los Angeles work submitted by Dockweiler, which will be referred to in the discussion of Dockweiler's assumptions.

Dockweiler, admittedly without experience upon construction work, as has already been shown, says (5201):

"MR. McCUTCHEN: Q. Exactly, and I have asked you three or four times if you have ever seen a puddle core put in?

"A. No, I cannot say that.

"Q. And you don't know, except from hearsay, how it is done, do you?

"A. I have had it explained to me by men who have done it." And again, when under cross-examination by Mr. McCutchen, upon

the details of his estimate upon handling excavation by teams with reference particularly to the idle stock on hand (5206):

"MR. McCUTCHEN: Q. It is fair to say that all you know about these matters that you are now telling about is what somebody else has told you?

"A. I took it on the best of authority. * * * * I got that from information, and from the records of others."

His estimate is purely synthetic based (5030 et seq.) upon the use of steam shovels handling an average of 900 cubic yards per day (5038) 300 running days a year allowing for the possibility (5044) of interruption thirteen days in a year, and assuming that for every other day the contractor would have to deliver 900 yards. As against this, note his citation that on the Central reservoir, out of 212 days the steam shovel worked but 139 days, though there were other delays than those caused by rain, and he admits the greater rainfall at Pilarcitos. Nevertheless, he allows but 13 days for stoppages (5044) due to wet weather. In addition to this he makes an allowance of 10% for loss in time, on the strength of a letter from H. L. Jacques (5034) relative to the Franklin Canyon dam work in which Jacques gives his impressions which were not based upon the actual complete records of the work (5033). The records of the performance which he gives of the Model 40 Marion Shovel used at Los Angeles. to wit, 691 cubic yards, 384 loads, in 8 hours with 11 teams and 1100 foot haul; 1076 cubic yards, 598 loads, in 8 hours with 14 teams and 2500 foot haul; 1186 cubic yards, 659 loads, in 8 hours with 15 teams and 2450 foot haul; and others—were all based upon observations taken, metaphorically speaking, with stop watch in hand, and actually for periods of a few hours or a few days, but in no case from the completed records of the work or from the records extending over any substantial length of time.

He conveniently forgets the increase which must result in the final cost of these embankments from such work as he admits was done at a later stage upon the lower Franklin dam, of which he says (5194), "In that process as it is now being carried out

the material is excavated by the steam shovel, then transported a certain distance and dumped and a stream placed on the dump and it gradually washes the material to a sump; at this sump it is taken by a pump which transports it a certain distance. Between the first pump and the dam a second pump is introduced to give it the additional lift. The water is forced on to the dam through a pipe and this pipe is carried to different portions of the dam just as the requirement is called for for material. The pipe empties at the edge of the embankment, that is, it either empties at the lower edge and the fine silt flows toward the center and the sandy material is left on the edge. That hold as to the lower side of the dam. Then on the other side where it joins with the earthen dam——

"MR. McCUTCHEN: Q. Mr. Dockweiler, I have not asked you anything about this. A. I am describing to you what I have seen."

Compare with Dockweiler's visionary 900 cubic yards per day steam shovel output, Dillman's statement that he would expect a steam shovel if it moved 600 yards a day to move in a month 12,000 to 15,000 yards (5289) and that the daily capacity of a shovel which will, if used normally, move 600 yards (5292) is considerably more than 600 yards; Herrmann's statement that even in fair weather the lost time amounts to from 25% to 35% and not 10% as Dockweiler allows; and Elliott's testimony that his careful analysis of the Mulholland available records of steam (5383-4; 5405-5407) shovel output indicated the following approximate figures: San Fernando, 350 and 580 wagon loads per day; Upper Franklin, 450; Lower Franklin, 502; as against Dockweiler's statement of 384, 598 and 659 wagon loads per day (5033) and that the conditions were not (5389) comparable; that the conditions at Pilarcitos dam were much more difficult, and would, therefore, involve much higher cost than at the San Fernando, Los Angeles or Calaveras dams (5397).

We may well dismiss Dockweiler's estimate without further

comment, for it is little better than a guess, not even an educated guess.

Dillman's estimate upon the embankment, 40c per cubic yard, is inadequate because in making his estimate he admittedly does not contemplate building such structures as actually were built by Mr. Schussler, but such structures as he thinks might serve. The character of his substitutes is indicated by his allowance of 4% to 5% for settlement, as against Ellis' 4 to 5-inch settlement at the end of three years in the Tabeaud dam, which (5241) was 120 feet high, a settlement equivalent to about one-third of 1%, and Ellis' expectation that the settlement of the Pilarcitos dam might be 1½ feet, although he doubts if that of the core wall would be as great; and as against Hazen's statement that there should be substantially no settlement in a well-compacted dam.

Dillman's contemplated construction is of the type which has been used so often and so disastrously in some of the smaller irrigation projects, and which have later failed. He might well have been the engineer who built the Otay dam. His estimates are, therefore, not comparable or significant.

(5159) "MR. DILLMAN: Yes, surface soil would not be objectionable. I would not object to going deeper for the material.

"MR. McCUTCHEN: If you could get enough surface soil free from roots and from vegetable matter, you would use that for your puddle core? A. Yes."

* * * * * * * *

"A. I would wet it [puddle core material] and puddle it in a variety of ways. It could be done by hand.

"Q. I am asking you how would you do it for this price you have given? A. I should prefer to do it with animals.

"Q. Describe the operations? A. Wet the material down in place and have it quite wet and lead animals through it until I was satisfied with the puddle."

* * * * * * * *

"Q. As you were making your puddle wall or puddle core, would you be carrying up the inside and the outside of the dam at the same time? (5160) A. Yes, sir.

"Q. And you would simply throw that material in loose?

"A. That would be thrown in loose; it would be compacted some in the way of handling. * * * * * by the animals and the wagons going over it. * * * It would be a little less in volume than it was in the borrow pit."

(5161) "Q. And you did not intend to figure upon a structure that would be a homogeneous mass?

"A. It would not be a homogeneous mass any way you could build it.

"Q. Was this work a homogeneous mass, in your opinion, immediately after its completion? A. I don't think it was.

"Q. Do you think, if instead of dumping the material in the manner you have described, you had provided for the wetting of the material from side to side and the rolling of it that it would probably have been a homogeneous mass when completed? A. It would not.

"Q. Would it have been more homogeneous than the structure which you have computed the cost of? A. I think it would.

"Q. Then you have not figured upon the reproduction of that structure as it was built, have you?"

Observe this answer:

"A. I don't know about the history of this except as I have heard it in the testimony here. There was nothing in my information, in the schedule or in plans furnished me by the Spring Valley or anybody else to indicate that this was carried up in any different way from what I have described.

"Q. If I understand you correctly, you do not lay much store on the puddle-wall anyway, do you? (5162)

"A. In the case of a dam I would depend on the puddle-wall or I would depend on compacting by depositing in layers and

wetting and rolling, but I would not depend on two ways of tightness in any structure.

"Q. Do you know of any dam built for the purpose of creating a reservoir to supply a large city with water, and upon the existence of which that city is dependent, that was ever built in the way you have designed this dam?

"A. As I think of it now the only supply reservoirs that I know of, earth reservoirs for supplying a large city, are these three, the two in this estimate and the Chabot dam. I think they were all built with the puddle-walls.

"Q. And you think that was unnecessary, don't you?

"A. No; either the puddle wall was necessary or the compacting of the general material of the dam was necessary.

"Q. But they were not both necessary? A. They were not.

"Q. You think it would have been perfectly prudent in these locations building dams for the purposes for which they were built, to have employed the methods employed in building the dykes in Holland? A. No; I think I would have employed different methods than that.

"Q. Didn't you say that the dykes in Holland were among the best ever built? A. No, I did not; I said they were among the greatest.

"Q. You did not say they were among the best? A. They were among the most important dams ever built, but they seep and seep considerably.

"Q. Would you advise the employment of the methods used in building dykes in Holland in the building of dams for the purpose for which these dams were built? A. No, sir; the material is not available and I don't think I should use it if it were.

"Q. Are these structures built as you now understand (5163) they were built better constructions than the ones you have provided for in your figures here?

"A. I don't think they are one cent better; they cost more money but they don't do the business any better.

"Q. How do you account for the fact that engineers who have built dams have not used your methods?

"A. Well, I don't want to account for anybody else's actions but my own in this world.

"Q. Well, you don't think it at all strange that the engineers who have been identified with the building of water works have not employed the methods upon which you have figured here?

"A. Well, I am not sure that I am surprised that other people have not followed my methods; they have not in a great many other particulars.

"Q. At any rate, as I understand you, you don't know of any case where your method was actually followed? A. Not for a city water supply."

* * * * * * * *

(5164) "MR. DILLMAN: There is not a question but what one method or another for tightening an earth dam is very essential.

"MR. McCUTCHEN: Q. After this structure as you have designed it was brought to its actual height would it all settle together or would the two sides settle and leave the puddle core in the air so to speak?

"A. There would probably be a little unequal settling, not enough however to disturb the puddle, not enough even to cast a suspicion on the integrity of the structure.

"Q. How much would that settlement be in a dam of this height?

"A. I think it would probably be in the aggregate 4 or 5%.

"Q. In the case of Pilarcitos, it being 70 feet, there would be a settlement of 3 feet, so that the puddle wall would be 3 feet above the rest of the structure? A. The puddle wall would also settle.

"Q. Would it settle 3 feet also? A. I am not sure what that would settle; it would settle some."

* * * * * * * *

(5165) "Q. You stated, Mr. Dillman, that you had no plans, that the Spring Valley Water Company did not furnish you with any plans; did you request anyone to furnish you with the plans of this work?

"A. Well, I didn't request any special plans. I was given plans, I was given this schedule.

"Q. Was that schedule a plan? A. No, but an inspection of the work and the schedule was all that seemed necessary."

* * * * * * * *

(5175) "MR. DILLMAN: Leakage is quite common."

* * * * * * * *

"MR. McCUTCHEN: Q. Don't you think a dam built in the way you have suggested here would leak? A. Very probably."

He does not state that the Pilarcitos and San Andreas leak, and Hazen states positively that they do not. He thinks that leakage is not of serious import up to the point where it is sufficient to carry material away with it. He admits frankly that the dam he has estimated upon would settle substantially, though he is in doubt whether the puddle core would settle in the same way as the rest of the embankment.

Enough has been said to indicate clearly that Dillman's estimate was not made upon the basis of the existing structures, but upon hypothetical structures built in a very much less substantial way than, and in no wise comparable with, the Pilarcitos and San Andreas dams. I say this with full knowledge that he later said he was reproducing these structures. That statement may fairly be judged by this testimony. Because of this fact, his evidence, therefore, is not significant.

A. P. Noyes gave no evidence upon reproduction cost of the earth dams of the Spring Valley Water Company, but testified merely to the cost of the Vallejo dam built by him in 1907-08—35c per cubic yard for embankment, which included, he thought, 8½% contractor's profit, and which was built by the use of New Era scrapers (5267, 5279).

It is to be noted, first, that the labor was paid $2.00 per day of 10 hours; second, that in Dillman's opinion the cost of excavation made with New Era scrapers is substantially less expensive, where practical, than other methods, but that these machines could not practically be used upon the construction (5279) of the Pilarcitos and San Andreas dams; and it is significant to note, as a matter of fact, and as appeared in evidence, that they have not been used generally upon dam construction.

It is to be noted further that the material of which the Vallejo dam was built was much more alluvial in character than that upon the site of the Spring Valley dams; was more abundant, and was conveniently near at hand. Furthermore, the position of the Vallejo dam would clearly make the labor conditions less trying than on the Peninsula.

The Vallejo figures, therefore, shed but little light upon the reproduction cost of these dams.

In passing, it is interesting to note that there was given point to the hazard element in the building of the Vallejo dam, for on January 1, 1909, a cloudburst flooded out the camp, and compelled the keeping of a large force of men to protect the contractor's goods, as well as the structure itself, by means of canvas, during a period of six weeks or more, and prevented the taking up of the active work from that date until the month of April. It appears extremely doubtful if Noyes could have known the cost involved by this disaster to the contractor.

I come now to the testimony of Ellis, who was the defendants' most experienced witness in the handling of earth work. He estimated the cost of these embankments (5231) at 50c per cubic yard or 51½c if (6020) the material was rolled in 6 or 8-inch instead of 12-inch layers. Contrast this with the actual Calaveras costs of steam shovel embankment work, 54c without material segregation and no sprinkling and rolling of material. He states that his experience upon dam work comes essentially from his inspection of the Tabeaud dam while under construction (5250).

He described in detail the methods adopted by Burr Bassell, who designed and built the Tabeaud dam, in Amador County (5223), for the Pacific Gas & Electric Co. in the year 1901.

(5249) The dam was built in a period of eight months; so short as to avoid the rainy season. He states that there was very little water in the canyon, to which but a small drainage area was tributary; the road construction was insignificant; good borrow pits were found near at hand (5246; 5248-50; 5253), in marked contrast to the "skin-work" involved in the construction of the Spring Valley dams (5251).

The dam was so very substantially built as to involve a settlement in the completed dam, 120 feet high, of but 4 to 5 inches in a three-year period of time (5241); whereas, in his estimate of the Spring Valley dams he assumes so much less exacting methods of construction as to involve a possible settlement of 1½ feet (5239-5241). Hazen, it will be remembered, stated that a well built dam, such as this, should not settle appreciably. He states further that the difficult foundation work was all done by the company before the letting of the contract, and is not included in the contract price of that work which was 40c per cubic yard. The wage paid upon the Tabeaud dam to common labor was $2.25 for 10 hours work (5233), but though in making his estimate of the Spring Valley dams he assumes a price of $2.25 for 9 hours' work, he estimates that the resulting increase in labor cost due to shortening a ten-hour to a nine-hour day, would be but 6% instead of 11 1/10%, stating further that a decrease in time from 10 to 8 hours would only increase the labor cost 12% (5233-4, 5258) instead of 25%, in his judgment. He admits, however, that Dorward's assumption that a decrease in the hours of employment of skilled labor from 10 to 8 hours would cause an increase of approximately 20% (5258). On a basis of his information concerning Tabeaud dam costs he estimates a contractor's profit of 7½% (5254), plus such profit as he allows upon the teams; he states that he never heard

whether the contractor made or lost money, as he does not know the complete cost of the Tabeaud dam (5243). The final costs involved much other work (5245), the cost of which he was unable to segregate. Furthermore, he states that his view would be the same, even though the contractor did lose money on the Tabeaud dam (5259).

Space forbids further argument upon this subject, but in concluding comment upon Ellis' testimony, we submit, that the difference between his estimate, 50c or 51½c per cubic yard if the embankment be rolled in 6-to-8 instead of 12-inch layers, with those of Hazen 60c and 65c and Herrmann 70c are readily accounted for by his inadequate allowance for contractor's profit; his assumptions in regard to the relative cost of labor upon a 10, 9 and 8-hour day; failure to make allowance for the difference in the labor conditions upon the Peninsula, near the city, as compared with the distant Tabeaud dam; the effect of shallow borrow-pits at Pilarcitos and San Andreas; the failure to recognize the more expensive preparatory work done by the company; and the very important difference of having either to carry the work on during the rainy season or to suspend the work over it, with corresponding loss in efficiency or cost of reorganizing the labor forces. These corrections could certainly raise Ellis' figures substantially, and it requires only a slight increase to make them the equivalent of Hazen's. Moreover, direct comparison of Ellis' 51½c with the actual Calaveras dam shovel embankment cost (54c), which excluded segregation, sprinkling and rolling of the material, clearly indicates on the basis of actual experience the inadequacy of his allowance.

Conclusion as to Cost of Embankment Work:

We submit, that the fair cost of the embankment work has been demonstrated to lie between 50c and 70c per cubic yard, and the gross amounts of $696,000 (Martin), and $505,000 (Ellis), and that the weight of evidence clearly indicates the fairness of Hazen's figure $646,291, as well as the inadequacy of Dockweiler's

and Dillman's figures, the latter of which was based upon structures incomparable with the existing Spring Valley dams, the former an unreliable and unscientific guess.

Labor, Wages and Hours:

In connection with the estimate of the earth dams and flumes, it may be of service to the court to note briefly the assumption of the different engineers concerning labor schedules.

(5099) Hazen assumed wages of $2.50 for 8 hours' work.

(4973) Herrmann was approximately the same.

Martin took $2.75 for 9 hours, with a range from $2.50 to $3.50 for unskilled labor (7719). He says further in substance that he understands, as a man who handles and hires workingmen, that higher wages are paid in or near large cities, and he knows that the labor unions hold one closer to their rules here than they do in the mountains; that he has not carried on any work in this vicinity, but that in his Sierra work he paid from $2.50 up, is now paying 25c an hour, and during the better times, of two or three years ago, $2.50 and $2.75, and that at the higher elevations he paid $3.00 in the late fall, owing to the extremely cold weather (7720).

(5048) Dockweiler assumed $2.50 for a 9-hour day.

Dillman took $2.50 on not less than a 9-hour, and perhaps (5015) a 10-hour day. He thinks there is small danger of interference with the laborers by the union.

(5233) Ellis figures $2.50 for 9 hours' labor, but as already stated, modifies his labor cost with the reduction in daily hours of employment on a basis of about 50% of the pro rata increase.

Conclusions Upon Reproduction Cost of Earth Dams (Including Stone Dam and Upper Crystal Springs Dam):

Summarizing the evidence bearing upon the fair allowance for the reproduction cost of the several items entering into the earth dams, we submit that Hazen's estimates were well sustained. I now present Table 18. This table covers Mr. Hazen's costs for six items noted on the table:

Table 18

		Amount including the Upper Crystal Springs Dam.
1.	Excavation	$ 37,965
2.	Puddle trench excavation	82,362
3.	Auxiliary structures	200,170
4.	Miscellaneous	80,325
5.	Puddle fill	161,637
6.	Embankment	646,291
	Total	$1,208,750

Excludes from "Auxiliary Structures" ($201,561) an item of $1,391 covering extra lumber piled along flumes, which is included in the agreed "stock on hand."

2b. Flumes.

We next turn to flumes. As previously stated the flume estimates may be segregated into the following items as shown on the accompanying table, which I now present to your Honor:

Table 19.

Item	Hazen	Herrmann	Dockweiler	Dillman	Joint Exhibit
1. Lumber	$197,522	$194,228	$176,006	$175,203	$183,000
2. Excavation	90,350	101,236	45,886	48,147	.....
3. Miscellaneous	15,148	15,604	13,628	13,360	.....
4. Extra lumber piled along flume, excl. from Earth Dams	725	809	.....	30	.....
	$303,745	$311,877	$235,520	$236,740	Incomplete

Substantially the entire difference between the estimates is to be accounted for by the various opinions held upon the cost of the benching or excavation for the flumes, and this is, perhaps, not to be wondered at, in view of the very different character of the hillsides upon which such structures have been built.

The excavation item was segregated in the inventory into three classes—earth, loose rock and hard rock. Comparison is

made between the figures submitted by the several witnesses upon these different items in Table 20.

Table 20.

Plaintiff Witnesses

Excavation:	Hazen		Herrmann		Martin		Lawrence
59,200 c. y. earth.....	40c	$23,700	50c	$29,600	40c 50c	$26,640	Pl. Exh, 109 E-4 34,170 c. y. grading Stone Dam Acq. Flume in Act Av. 1898 55.6c Resolved (1913) 65c.
24,932 c. y. loose rock.	$1	24,932	$1.20	29,918	$1	24,932	
20,859 c. y. hard rock.	$2	41,718	$2	41,718	$2.75	57,362	
104,991 c. y.....		$90,350		$101,236		$108,934	
Average per Cu. Yard.		86c		96c		$1.03	

Defendant Witnesses

Excavation:	Ellis		Dockweiler		Dillman		O'Shaughnessy
59,200 c. y. earth.....	32c	$18,944	30c	$17,753	25c	$14,800	Slightly less than contract price grading Hetch Hetchy R. R. line of 67c.
24,932 c. y. loose rock.	65c	16,206	50c	12,488	50c	12,488	
20,859 c. y. hard rock.	$1.25	26,074	75c	15,645	$1	20,859	
104,991 c. y.....		$61,224		$45,886		$48,147	
Average per Cu. Yard.		58c		44c		46c	

Experience of Witnesses:

Hazen states (5214) that his judgment upon the cost of benching for the flumes was determined after walking over them; seeing what the work was, talking with Lawrence, going over his available cost figures, and then making up his mind upon the fair average price which might be placed upon excavation on this work. Upon the building of the timber structures, Hazen stated that he had had no experience, and had been guided wholly by Lawrence's figures and judgment. Upon the cost of handling different classes of earth work, however, Hazen had had wide personal experience.

Herrmann says (5362) that he had in mind the excellent character of these flumes, the workmanship, and the great care used in their construction, and that he had before him the cost of a number of other more or less comparable flumes that had been built under his direction, among them the flume of the main canal of the Modesto Irrigation District from Indian Hill to Dry Creek, a distance of about 20 miles. and consuming upwards of a million board feet of lumber; the flume from the La Grange dam to Mill Gulch (5363) in the Modesto Irrigation District, having a length of 3700 feet, built along the bank of the Tuolumne River, involving approximately 360,000 board feet measure; (5363) the Hilts Sag flume of the South San Joaquin Irrigation District, something over 2,000 feet long, having inside dimensions of 9x12 feet, and built for a considerable distance on a high trestle; (5365) the new River flume in the Imperial Valley, about 1400 feet long, part of it on a high trestle, involving about 600,000 board feet of lumber; the rebuilding of the flume of the San Jose Water Company in the Los Gatos Canyon. between Alma and Los Gatos; and that he had had many conferences with various members of the Spring Valley Water Company and others. His large practical experience certainly entitles his opinion to substantial weight, the more so because his experience was had in the vicinity of the plaintiff's structures, rather than in the building

of flumes in the high Sierras where the topographical, geological and meteorological conditions are all somewhat different. He is the most experienced witness called upon this subject.

Dockweiler had had no personal experience in flume construction. His excavation prices were based he says (6181-2) upon his knowledge of what similar work is done for in this region, referring especially to the cost of road building in the Lagunitas section in Marin County, San Anselmo, Ross and Hetch Hetchy, which is not, in fact, similar in character.

Dillman states (6158-9) that his closest connection with flume construction was in the building of a couple of miles of flume for the Rio Bravo Ranch in 1894; that he had some connection with various flumes in the mountains every two or three years since, the most recent being the Oakdale Irrigation District in Stanislaus County. He mentions, too, the Hilts Sag flume referred to by Herrmann. He, too, admits the excellence of the Spring Valley flumes (6343) and even goes so far as to say that they are probably better flumes than he would build for the purpose.

Martin had had experience in building flumes for the Pacific Gas & Electric Company at a number of places, as at the Centerville ditch (7689); at the Gold Hill dam; and a number of others in connection with various power developments.

Martin refers particularly to the necessity for care in benching, or making the grade for the flume, and the increase in cost of blasting due to the light overburden and the skin work, the heavy cost for powder in bull-dozing, and of trimming up the grade after blasting.

Lawrence, as superintendent of the country division of the Spring Valley Water Company's property, has had a large experience in building the flumes for the company under Mr. Schussler's direction, and gave particularly valuable cost data which may have been incomplete, but which at least represented the costs which he personally knew had been incurred. These costs were

available in his office records though he stated that adidtional expense may have been involved and accounted at the main office, of which he would have no record. His data covered the grading of the stone dam aqueduct flume line in 1898, running from Tunnel No. 1 to No. 2, concrete dam to Tunnel No. 2, Tunnel No. 2 to siphon, and a little regrading of the line between the siphon and Tunnel No. 3 at the San Andreas dam, involving solid rock excavation of 3790 cubic yards, loose rock, 4388 cubic yards and earth 25,992 cubic yards, or a total of 34,170 cubic yards.

The total labor cost of this work in the year 1898 amounted to $18,997, or as "resolved" by him to 1913 prices, $23,938 for grading and clearing costs, or $22,178 for grading costs alone. Lawrence attempted to segregate this total cost according to his judgment, as between the different classes of material excavated, and finally fixed the price for solid rock of $1.50, loose rock $1.00 and earth 46.6c.

Interesting as this segregation is, the really important element of the comparison is the average cost of this work in 1898, of 55.6c per cubic yard, or as "resolved" to 1913 labor prices, 65c per cubic yard, upon material, 76.1% of which was earth, 12.9% loose rock, and 11% solid rock, as shown by Lawrence's Exhibit 109, E-4. It is not clear, either, that these allowances cover the entire cost of the work, as some tools, powder, materials, or supplies may have been furnished to Lawrence's department and accounted in the central office only, with no record in his office.

Ellis, who testified for the defendants, had also had considerable experience in flume benching,—in the construction of the Standard Electric canal in Amador County, in the canyon of the Mokelumne River, which had involved between 550,000 and 600,000 cubic yards of material; had done excavation work upon the Crocker Tract in the soft sandstones on the Peninsula, and had general knowledge of the cost of handling earth work in different kinds of materials.

Comparison of Estimates of Flume Benching Costs:

Hazen estimated the benching cost at the average cost per cubic yard upon the entire amount of 104,991 cubic feet (59,200 cubic yards earth, 24,932 cubic yards loose rock and 20,859 cubic yards hard rock) at 86c; Herrmann, 96c; Martin, on the basis of Sierra conditions, $1.03; Lawrence, on the basis of the stone dam aqueduct flume benching in 1898, 55.6c, and as "resolved" to 1913 figures, 65c; Ellis, 58c; Dockweiler, 44c; Dillman, 46c; and O'Shaughnessy gave the cost of the Hetch Hetchy right-of-way as being 67c.

We apprehend that the divergence in estimates grows out of the real difficulty in determining the average conditions involved in doing this work, as compared with those involved in the construction of other flume benches, with the cost of which the several engineers were familiar. The relative standard of workmanship and care required in the building of the structures may also well have been factors, as indeed the assumed rate of wages.

Under these circumstances, the greater weight should attach to the actual cost records as submitted by Lawrence, derived by him during the reconstruction of the stone dam aqueduct flume in 1898, and "resolved" as to labor prices to the year 1913. His figures showed an actual original average cost of at least 55.6c per cubic yard, and a resolved cost of 65c upon the entire 34,170 cubic yards,—approximately one-third of the entire amount of the flume work here under estimate. A marked and indeed controlling difference is to be noted, however, between his work and the work here under estimate, to-wit,—that in rebuilding the stone dam aqueduct flume the earth work constituted 76.1% of the entire excavation, the loose rock 12.9%, and the hard rock 11%, whereas of the entire schedule now under estimate but 56.4% was earth, 23.7% loose rock, and 19.9% hard rock. To put the matter differently,—upon the present schedule the loose and the hard rock excavation is practically one-half the entire excavation, while the earth excavation is three-quarters of the amount upon the

stone dam aqueduct construction. If, therefore, we apply a ratio of price of the rock work to the earth work of 3 to 1, to adjust Lawrence's "resolved" (1913) figures of 65c per cubic yard, to the different rock and earth ratios here prevailing, his 65c figure would be increased to 82c per cubic yard, and if a ratio of 3½ to 1 be used to 85c per cubic yard. Hazen's ratio was approximately 3.6 to 1, Dillman's 2.9 and Ellis' 2.9. The computation is an involved one, and it has been extremely difficult for me to follow; I know that Mr. Sharon will be glad to take it up with Mr. Ellis and check it; I don't want to go into the details of it here.

THE MASTER: Have you figured the actual yardage of the different classes of material at Mr. Lawrence's figures?

MR. GREENE: I have those figures here. It will be recalled that Mr. Lawrence's figures were 46.6 a cubic yard for earth, $1.00 for soft rock and $1.50 for hard rock.

THE MASTER: Those were actual costs, were they, or revised costs?

MR. GREENE: These were revised costs. Making the computation on the actual yardage for all the flume benching on the basis that we made in the original argument we get 59,200 cubic yards of earth at 46.6 cents, making $27,587; 24,932 cubic yards of loose rock at $1.00, $24,932; 20,859 cubic yards of hard rock at $1.50, $31,288, or a total of 104,991 cubic yards at $83,807, or an average of 79.8 cents per yard, which is to be compared with Mr. Hazen's 85 and a fraction cents per cubic yard.

We submit, therefore, that the actual cost figures upon the construction of the flumes fully and fairly justifies Hazen's average unit price of 86c, and his total amount of $90,350, and that confirmatory strength is lent by Herrmann's and Martin's estimates. Dillman's figures upon excavation cost again reflect an attitude of mind similar to that under which he estimated the construction of the earth dams to be built in a manner which

seemed to him good enough, but which was not in accord with the actual character of the structures built by Mr. Schussler. The difference between Ellis' figures and the actual Spring Valley construction costs probably reflects the difference in the character of the construction and of the topographic conditions encountered,—which are obviously extremely difficult to gage,—as well as Ellis' assumptions relative to the effect upon the cost of reducing the hours of employment for a given wage, as has been pointed out heretofore in connection with the subject of earth work involved in the riveted pipes outside of the city. O'Shaughnessy's figure is not of controlling importance because of the very different character of the work, mass work rather than skin work, the far greater volume of the work involved, and the further fact that the record does not show whether the contractor upon the Hetch Hetchy work cited by him, was able to do the work at the figure mentioned, or suffered heavy losses, and perhaps involved the city in further expenditures.

MR. SEARLS: I would like to show you the sub-contract figures on that.

MR. GREENE: Well, I don't think the suggestion is a vain one, your Honor, in view of the record we submitted this morning as to the various contracts for work on the city's high pressure system.

Adding to the above amount of $90,350,—covering the excavation or benching for the flume,—the agreed value of the flume lumber in place, as shown in the Joint Exhibit, $183,000; and Hazen's allowance for miscellaneous work upon the flumes, $15,148; we have the total sum of $288,498, which the evidence supports. We have eliminated in this sum ($288,498) an item covering flume lumber ($725) which is included in agreed stock-on-hand.

Summary of Earth Dam and Flume Excavation:

Adding the sums previously arrived at,—on earth dams $1,208,750, and upon flumes $288,498,—we find the total fair allowance to cover items "2a and b Earth Dams and Flumes", and item "7 Upper Crystal Springs Dam" to be $1,497,248.

3. Tunnels

We come now to a consideration of the tunnels, 16 in number, —8 upon the lower Peninsula, 3 upon the upper Peninsula at Lake Merced, Lake Honda and Bernal, and 5 upon the line of the Sunol aqueduct.

The reproduction cost estimates on these tunnels were,— Lippincott, $1,100,757; Hazen, $1,124,095; Dockweiler, $833,963; Dillman, $650,183; after making correction in Dockweiler's figures on account of statutory restrictions in the employment of miners, —8 hours per day,—and in Dillman's for timbering. All of these figures exclude allowance for overhead and interest-during-construction, charges.

The basis for Lippincott's estimate is shown in Plaintiff's Exhibit 133, pages 1 to 25; and in Plaintiff's Exhibit 138, embodying a joint study by Lippincott and Hazen of the Los Angeles aqueduct overhead costs; Hazen's in Plaintiff's Exhibit 139, 12 pages; Dockweiler's in Defendants' Exhibit 141 (corrected), 4 pages, and in the revised sheets on tunnels showing comparison of reproduction cost estimates as summarized in the Major Group Schedule; Dillman's figures being covered only in his inventory of the property.

List of Witnesses for the Plaintiff.	List of Witnesses for the Defendants.
1. Lippincott, J. B.	1. Dillman, George L.
2. Hazen, Allen	2. Dockweiler, J. H.
3. Lawrence, W. B.	3. Phillips, J. J.
4. Sharon, J. J.	4. Kast, Marius J.
5. Elliott, George A.	5. Higgins, Robt J. (deceased).

Experience of the Witnesses.

The principal witnesses for the plaintiff were Lippincott, principal assistant engineer to Mulholland on the construction of the Los Angeles aqueduct, and probably the most experienced engineer on tunnel driving on the Pacific Coast; and Hazen, who, himself experienced in driving tunnels showed a thorough familiarity with the character and cost of the most important water works tunnel construction that has been done in this country in the past 15 years or more; who had repeatedly had occasion to make plans and estimates for tunnels, some of which had been built, others not; and who had made the most careful and intelligent study of the experience and cost records of the Spring Valley Water Company in the actual building of these tunnels. Lawrence supplemented Hazen's work by testimony concerning such portion of the cost of the tunnels built by the Spring Valley Water Company as he had records of in his office at Millbrae, although he knew that in a number of cases his records were, in fact, incomplete on account of the sending to his department of material which was paid for through the central office, and of which no cost record, therefore, had been kept in his office. Sharon and Elliott gave supplementary evidence concerning past costs of the company and records of construction.

For the defendants, Dillman and Dockweiler were the important witnesses,—the testimony of Phillips, Kast and Higgins being limited to the cost of brickwork.

Dillman showed himself to have had substantial experience in tunnel work, but it was limited almost entirely to the building of railroad and mine tunnels, and he had had no experience in the building of masonry lined tunnels, and showed himself ignorant of the very important interrelation between the cost of the excavation and of the lining involved by the necessity of exercising care in the drifting, in order to minimize the overbreak,

the importance of which was clearly recognized, and repeatedly referred to by Lippincott and Hazen.

Dockweiler's experience proved, on detailed examination, to have been negligible as compared with Hazen's and Lippincott's, and on a character of work incomparable with the Spring Valley tunnels. He had had no experience in the driving of lined water works tunnels, and had no appreciation of the resulting difference in cost of construction, compared with the drifting of unlined or timber lined mine tunnels.

Lippincott (6611) has had to do with the driving of perhaps a dozen tunnels in the canyon of Santa Ana, in San Bernardino County, California, in the early 90's; had a long and tedious experience in connection with the driving of a tunnel for the City of Santa Barbara through the Coast Range, 4 miles long; was connected with the driving of about 120 or 130 tunnels on the Los Angeles aqueduct through a variety of formations, all the way from stratified chistose rocks and soft sandstones, to hard granites; was connected with the driving of 11 miles of tunnels in the Hawaiian Islands through volcanic rock, and all told has had to do with the driving of perhaps 150 tunnels through an aggregate length of perhaps 60 to 70 miles. As further evidence of his competency, note his concise and admirable discussion of tunneling methods, and costs, Plaintiff's Ex. 133, pp. 1 to 6. (6612 to 6620).

Lippincott examined each of the tunnels of the Spring Valley Water Company with care (6620), was familiar from personal experience with the character of the material in the Sunol Canyon, as a result of visits to the tunnels driven by the Western Pacific Railroad during their construction (6855), and had previously made with Mulholland a report upon Freeman's estimated cost of driving tunnels through the Coast Range for bringing the Hetch Hetchy waters to the City of San Francisco, as was referred to by Wadsworth. No man upon the Pacific Coast has had greater experience than Lippincott in actual tunnel driving and

in the keeping of intelligent comparative cost records relating thereto, as was done under his personal direction upon the Los Angeles aqueduct, for instance.

Hazen had driven the Little River tunnel of the Springfield, Mass., Water Works, and a number of others, such, for instance, as that under the railroad yards at Albany, running diagonally across the main line of the New York Central Railroad, and a tunnel in Watertown, New York., through limestone (6913) His Little River tunnel, driven in 1908, he thought directly comparable with the Spring Valley structures (6707). Hazen had, moreover, connection with the driving of many other tunnels, had acted as consulting engineer for works where tunnels were driven, made estimates for them, and studied and been familiar with tunneling conditions and costs. He had made estimates for some tunnels in this neighborhood for the City of San Francisco, in connection with Freeman's investigation and report, getting such data as he was able to at that time, from such persons as Manson, then City Engineer, Connick, Ransom, and others (6708). He was thoroughly familiar with the available cost and construction records bearing upon the building of the Spring Valley tunnels (6691), and presented a most interesting and significant analysis of these in his Plaintiff's Ex. 139.

A few years ago in connection with a report upon the sewerage system for the City of Pittsburg, he, with the aid of his partners, had made a careful and critical study of all water works tunnels which had been driven at about that time in this country (6701-2), and he presented in his Plaintiff's Ex. 139 interesting comparative data relating to these, and to some others. (6710 et seq).

Dillman stated that he had been connected with tunnel work since 1890, usually as engineer in charge of their planning, laying out and construction, that he had prepared specifications, and supervised contracts. His first experience was practically entirely in railroad tunnel work, but recently he had had experience in the driving of some small water tunnels for the Oakdale Irriga-

tion District, which he said furnished him the most pertinent definite information which he had (6791); he referred to his work as consulting engineer to the Utah Construction Company, which he characterized as the ablest tunnel driving concern west of Chicago, the work of which, was limited, according to the examples cited by him, to unlined mine tunnels and railroad tunnels.

Dillman had had absolutely no experience with lined tunnels.

(7051)"MR. McCUTCHEN: Mr. Dillman, do you know of any tunnel anywhere, through any class of material, that was driven and fully lined with either brick or concrete for $10 a running foot?

"MR. DILLMAN: A. No, sir. I have had very little to do with lined tunnels. I have never lined a tunnel with brick. I have never completely lined a tunnel with concrete; my tunnel linings have generally been timber.

(6801) "MR. McCUTCHEN: Did you make any analysis of that [his cost of $25 per thousand for brick lining]?

"MR. DILLMAN: A. No sir; I place that value on the brick, not because I had ever lined a brick tunnel or knew definitely the cost of putting the brick lining in a tunnel, but because I believed it was not better than concrete, and should not have been used if it were more expensive than concrete; concrete at $12.50 a cubic yard would make the equivalent volume of lining of brick $25 a thousand."

(7092) "MR. McCUTCHEN: Did you ever drive a tunnel in wet sand?

"MR. DILLMAN: A. No sir, I got into a tunnel once in sand that gave me a good deal of trouble; it was dry, though."

(7097-8) "MR. McCUTCHEN: And have you ever seen any figures on the cost of running tunnels in wet sand?

"MR. DILLMAN: A. No sir, I do not think that I have.

"MR. McCUTCHEN: And you have said that you have never had any experience in running tunnels in such materials yourself?

"A. No sir, I have not.

(7086) "MR. McCUTCHEN: You did not say anything about the cost of running Western Pacific tunnels?

"MR. DILLMAN: A. I don't think I know definitely what they did cost."

All this time Mr. Dillman and Mr. Dockweiler had in their possession the cost of the Sunol tunnel which was built by the Western Pacific.

"MR. DILLMAN: I have not related my estimate in these tunnels [Spring Valley] directly to any one tunnel, or any one set of tunnels as closely as to the Oakdale work with which I was recently connected. It went on during the time that this work is supposed to have been done; it was finished in 1913. I knew more of the main facts then than of the collateral facts and conditions there. They were small tunnels. Therefore, I considered (7087) them more pertinent than any other information."

* * * * * * * *

"The north side Oakdale tunnels; there are 5 or 6 tunnels there."

"MR. McCUTCHEN: These tunnels run through soft material?

"A. Yes."

* * * * * * * *

"MR. DILLMAN: Well, it was softer [than the Spring Valley tunnels]."

* * * * * * * *

"Q. What did you mean by that just a little bit softer?

"A. I meant that you could bore them instead of having to drill them.

"Q. And you could not bore the Spring Valley tunnels?

"A. No.

"Q. You could cut that material at Oakdale with a knife, could you; you could whittle it with a knife? A. Yes."

* * * * * * * *

"Q. Is it your opinion, as an expert tunnel constructor, that

there is any comparison whatever between those two materials?

"A. Yes, sir.

"Q. How would you make that comparison, how would you use it?

"A. The main difference is the way in which the holes would be put into the material."

* * * * * * * *

(7088) "I think the hard material would shoot almost the same, and possibly better than the soft material of Oakdale. It would cost about the same amount of money to muck and handle the material after it is shot."

* * * * * * * *

"I would not expect to bulldoze much of this.

"Q. You had to break that material with a sledge? A. Yes, sir.

"Q. Notwithstanding that, one crew could take out from 8 to 10 feet of it on a shift? A. Yes, sir.

"Q. Did you ever hear of half of that much being done in any material where you had to drill? I understood, by the way, you would expect to take out 3 feet in this material.

"A. Yes, I think I have; I think if you will give me a little time I can cite a good many hard rock tunnels to you where they have taken out more than 5 feet."

We ask your Honor to look through the record for these examples.

Dockweiler states that he drove three tunnels in 1893, as City Engineer of Los Angeles, for the outfall sewer; one of them 5800 feet long, the other two comparatively short. In 1900 he did a little tunnel work in Fresno County, in the foothills, probably 300 or 400 feet in length, for certain mines; he is now having a tunnel driven in the Los Burros Mining District, which he says will be 2000 feet long when finished, of which amount less than 400 feet had been driven at the time he testified, and no part of which he had seen up to that time (6734-5).

He made a study of such of the original cost records of the Spring Valley tunnels as he was able to get.

It thus appears that Dockweiler's connection with tunnel work was nominal, of ancient origin, and that the little comparative data which he had, other than that relating to the cost or partial cost of certain of the Spring Valley tunnels, was largely incomparable with his structures under estimate. We may add, further, that Dockweiler's ignorance of the statute limiting the hours of employment of miners to 8 hours per day gives significant evidence of the superficial character of his information upon tunneling costs. Counsel's generous offer to assume the burden of that error cannot disguise Dockweiler's incompetency.

As the other witnesses gave only incidental testimony in the discussion of tunnels, such reference as has to be made to their experience will be made in connection with reference to their testimony.

Basis of Estimate.

Lippincott: After examination of the tunnel sites and structures, so far as they could be seen, Lippincott made an estimate of the reproduction cost of the tunnels, just as if he were making detailed report upon them to any client, upon the basis of his broad experience and office records, first analyzing those of his records which he thought most significant for purposes of comparison. His brief statement upon "Tunnel Methods and Costs," which he presented in Pl. Exh. 133, supp. pp. 1 to 6, and which was covered in his testimony (6612-20) was a concise and masterly statement of the more important considerations involved in such estimate, covering drilling, mucking, transportation, ventilation, powder, rails, methods of driving, width, height, and length of tunnel, and occasion for heavy expense, including in the latter a consideration of the character of the material, timbering, overbreak, water and gas, and the relation of the hardness of the material to the drilling and to the powders to be used. Then he discussed specific examples of tunnels built by him, or under his

direction, which will be referred to hereafter under comparative data on tunnels, and his methods of treating auxiliary and overhead expenses, as a result of his broad experience in such work. (6623; 6906; Pl. Exh. 138.)

Lippincott figured his own quantities (6660), finally reducing his figures to a per-lineal-foot-of-tunnel basis, in order that his own records might have proper application to the structures under estimate, the necessity for which is obvious.

Lippincott's figures were based upon the assumption that the company would do the work itself, by day labor, instead of under contract, and he allowed no contractor's profit therefor in his figures (6905). The unit prices used by him are shown in his Pl. Exh. 133 and in his testimony (6643-56; 6888-9; 6672, etc.) and will be referred to hereafter under price of materials.

Lippincott assumed that the material was too hard to use augers (6904), that hand-drilling would prevail on the smaller Peninsula tunnels, compressed air machine drilling on the others (6815; 6612-13). He stated that his Honda figures were somewhat too low, because he had not allowed for the encountering of rock (6885; 6908), as were also his Merced tunnel figures on account of his failure to make sufficient allowance for wet work, for the difficulties encountered and for the greater thickness of lining, resulting from using a 12-inch ring instead of a 9-inch ring in certain sections of the tunnel.

Hazen based his judgment on two lines of evidence; first, the original cost of the tunnels as worked out by him with the aid of figures from Lawrence's and Sharon's records and from information given him by Mr. Schussler and others, concerning actual methods of construction used and difficulties encountered in the execution of the work. His discussion of the Spring Valley Water Company's experience in the driving of its tunnels,—grouping them into four periods, and showing the progressive increase in size of the tunnels as the result of experience, embodied in his Pl. Exh. 139, is very instructive.

The second basis used by Hazen in forming his judgment was a comparative study of the records of tunnel costs of waterworks, and some sewer tunnels, built in this country during the past 15 years, more or less. These he grouped into four classes, dependent upon size and period of construction, making his comparison of costs on a basis of the cost of a standard tunnel equivalent to a circular cross-section of 6 feet internal diameter, in accordance with his established office practice. Finally, he gave weight to the information which he had acquired several years ago from Manson, Connick and Ransom, when making estimates upon tunnel construction in this vicinity, incident to the bringing in of Sacramento River water to San Francisco, for Freeman's report, when, by the way, he was in the city's employ.

As a result of these studies Hazen assumed as a standard of cost, of his normal typical Spring Valley tunnel, $35 per linear foot for a tunnel of internal cross-section equivalent to a circle 6 feet in diameter; $30 for 5 feet in internal diameter; $27 for 4 feet; and $25 for 3 feet, as appears at the beginning of his Pl. Exh. 139 and in his testimony (6719; 6915-16), and varied these standard prices to fit individual cases in accordance with broad judgment after weighing such facts as were available with regard to construction conditions encountered.

Hazen (6691; 6913-14) as well as Lippincott (6618; 6852; 6853½) called attention to the difference between the construction of railroad tunnels, mine tunnels and waterworks tunnels, the latter of which are much more expensive to build, because of the fact that it costs much more per cubic yard and per linear foot to make a small drift, as in the waterworks and mine tunnel, than in the large drift of the railroad tunnel, which is made by first driving a small tunnel and then breaking down the walls of the tunnel in order to enlarge the section. He further states that it is more expensive to drift for a masonry lined tunnel, such as the waterworks tunnel, as compared with an unlined or timber-lined mine tunnel, because of the necessity of holding the excavation

as nearly as possible to the theoretical lines, and thus preventing "overbreak," in order to minimize the amount of the masonry lining required to backfill the "overbreak" space solidly, as will be discussed in detail under the subject head of "Overbreak."

Hazen says (6708):

"Tunnels of this kind are not driven every day. The total number of them in the United States comparable to these tunnels is comparatively limited, and it obviously would not have happened to anyone in ordinary general practice to have driven a large number of them."

* * *

(6691) "The tunnels of the Spring Valley system are nearly all small lined tunnels; some of them are lined with brick, and some of them are lined with concrete. Very few tunnels of this description have been driven in California in recent years, and it has been particularly difficult to get an adequate and satisfactory basis for estimating the cost of reproduction for these tunnels. * * * Railroad tunnels have been frequently driven in California, but they throw very little light upon the cost of driving tunnels of this class, because a railroad tunnel is so much larger, and the method of driving it is different, and the cost per cubic yard is very much greater as the space in which the work is done is smaller. Many unlined tunnels have been driven, but the records of cost on such tunnels also are of little use, because when a tunnel is to be lined, and it is necessary to line a tunnel for water works purposes, where the rock is as soft as that about San Francisco, the cost of the driving and lining are tied up with each other, so that an estimate of either without the other is not of much use; that is to say, the economical way of cutting through, as far as the driving, alone, is concerned, is to blow out a good sized hole and push it ahead, and get the material out; so tunnels can be driven in that way for a certain figure, which is comparatively low. But when it comes to lining a tunnel that is driven cheaply in that way, it is necessary not only to place the

lining, but to fill up the space between the lining and your rock on the outside, to prevent against subsequent trouble with movement or settlement of the rock. So, if the tunnel is cheaply driven, it costs a great deal to line. On the other hand, if the work is in the hands of someone who has done it before, and understands the business, the driving will be done more slowly, and at a much greater expense, but with the result that a hole is produced that fits the lining throughout closely, and then the lining can be done economically, and the whole cost probably will be less than it would have been if the work had gone faster, and the driving had been done more cheaply; for that reason records of cost of lining or of driving by themselves, I do not consider as of very much service in this connection."

Dillman, as previously stated in the discussion of his experience, had unfortunately had no personal experience with masonry lined tunnels, and it was evident from his examination that he had no clear or just conception of the inter-relation between cost of excavation and lining, resulting from the overbreak referred to above by Hazen; moreover, he had specific knowledge in but one case concerning the cost of masonry lining, that of the cost of lining the Oakdale tunnels originally built as unlined tunnels upon the lining of which work was in progress. As will appear hereafter, he labored under a misapprehension as to cost of this, and subsequently corrected his statement of its cost when he had obtained further information concerning it; but he showed his mental bias in attempting to explain away the increased actual cost, instead of frankly admitting it and revising his figures in accordance with the error which he had discovered. He says that the work of driving small tunnels is done largely by expert gangs of tunnel sub-contractors. (6799.)

"There is a gang of laborers on this coast—I saw one of them only last week, they are very expert tunnel men, they don't do anything else when they can get tunnel work; I first got acquainted with them in connection with the Western Pacific

work; they are not day laborers, they are contractors; they are usually what are termed station men; that is, they will agree to go into a tunnel, or some other work, and do a definite amount of work, and their pay depends on the amount of work done and not on the time employed at all. They are to all intents and purposes contractors, but they are not financially able to take big contracts. But they follow the big contractors and the big contractors depend on them for doing this work. In that way they get the work done at a minimum price although the laborers get a maximum compensation. These tunnel men made at Oakdale, as I said, from $10 to $13 a day. The wise one of the bunch, I think his name is Svensen, got in there first and agreed to take all these tunnels at $10 per lineal foot. The Utah Construction Company was glad to get it off their hands at that rate and they let it. He turned around and sub-let to these station men—his own people—at $6.50 and raked off $3.50 a foot without striking a blow."

And again,—

(7051) "MR. McCUTCHEN: Q. Did you use the costs of the tunnels in the Oakdale District as a guide in fixing the cost of running these tunnels that we are considering here?

"MR. DILLMAN: A. I think I did in a certain measure. I knew of the work of these station men, and I knew that they were in the state at the time of this supposed work, 1907 to 1913, and my knowledge of what they could do in the tunnel excavation was largely derived from watching them do it in the Oakdale tunnels. I knew of some other work they had done. By the way, they are the same men who made the records on the Los Angeles Aqueduct tunnels. While the digging at Oakdale was a little bit easier, it was done at a much greater profit to the men. Putting it on a day's wage basis, the estimate per cubic foot of excavation is considerably larger for these Spring Valley tunnels than for the Oakdale tunnel. So I think I did use that information, but not resolving it directly without considering that the

Spring Valley tunnels are harder material; on the other hand, that is an advantage in a certain way, it stands better, it should stand better."

As appears above, Dillman "did in a certain measure" use the costs of the tunnels in the Oakdale District as a guide in fixing the cost of running these tunnels, and he estimated, as will appear later on, for his concrete lining, approximately $10 per cubic yard in place, without allowance for the additional masonry required by the overbreak,—incident to his method of tunnel construction and the extremely low price allowed by him upon the tunnel drifting or excavation,—though he admits when asked by Mr. McCutchen (7051):

"Q. Mr. Dillman, do you know of any tunnel anywhere through any class of material that was driven and fully lined with either brick or concrete for $10 a running foot?

"A. No, sir. I have had very little to do with lined tunnels. I have never lined a tunnel with brick; I have never completely lined a tunnel with concrete. My tunnel linings have generally been timber."

And at a later point (7099):

"MR. McCUTCHEN: Q. Do you know of any tunnel of any size anywhere that was driven and concreted for $15 a foot? Concrete lined, I mean?

"A. No. My experience with lined tunnels is very small, but I recited a contract [the Oakdale contract of Edward Malley] which has been let and is now being executed for a tunnel concrete lined that contains more material than the Peninsula tunnels of the Spring Valley Water Company, more excavation; I don't know how the lining will pan out—for less than $15 a foot.

"Q. That is not completed? A. It is not.

"Q. The contractor may fail? A. Yes.

"Q. Do you know of any tunnel of any size driven and concrete lined and completed, the cost of which was as little as $20

a foot? [Dillman estimated the reproduction cost of ten of the Spring Valley tunnels at less than $20 per foot.]

"A. My experience with concrete and brick lined tunnels is very slight. I have never built one myself, therefore, I shall have to answer no. Nor do I know of one that has been built and concreted for less than $50 a foot."

Yet Dillman in his estimate allows these men but $5 or $6 a day.

(7080) "They would not be paid in that way [i. e. on the basis of drilling, shooting, mucking, moving and blacksmithing]; they would be paid in proportion to the work done, and not in proportion to the time spent. I am proposing to do this with station men, and I would expect them to make very good wages at the price I have given, probably $5 or $6 a day."

It may well be asked whether he could obtain the services of these expert "station men" for his allowance of $5 or $6 a day, as he, himself, admits they frequently make from $10 to $13 a day.

Dillman, as the other engineers, based his estimate upon hand-drilling for the smaller tunnels (6799). He made very little allowance for timbering because, as he said, the inventory did not refer to it (7055). Under cross-examination he admitted that his allowance was probably less than that which he had indicated in the latter discussion should be allowed and later made correction of his figures for this factor, and these corrections have been included in the figures cited herein and now under discussion.

It is significant to note that Dillman assumed the rate of progress upon the tunnel construction of from 3 to 10 feet a day at each heading (7079),—a considerably greater rate of progress than assumed by the other engineers. This naturally leads to the inference that he gave undue weight to his Oakdale experience, in which no drilling was necessary, the powder holes being bored with augers, a method which he admitted could not be

applied to the Spring Valley tunnels on account of the greater hardness of the materials transversed by them (7063).

While Dillman admits the hazardous nature of tunneling (7082), he nevertheless founded his judgment in large measure upon the successful operations of the Utah Construction Company in driving unlined mine tunnels. While he was familiar with the great trouble experienced by the Southern Pacific Railroad on the construction of its tunnels on the Peninsula, he ascribes the difficulty wholly to the effect of earthquake faulting, and gives no weight to these costs in his treatment of the Spring Valley Peninsula tunnels (7068). Similarly, while he was familiar with the great difficulty experienced by the Western Pacific Railway in driving the Sunol Canyon tunnels, he excludes those costs too from consideration (7086-7), even the record of cost to the Western Pacific Railway of driving Sunol tunnel No. 2 for the Spring Valley Water Company in relocating its conduit line for the convenience of the railroad, which was far greater than his reproduction cost estimate for this tunnel.

Dillman holds that (6797) "while it is true that the cost somewhat increases as the section decreases, it is less true of small tunnels—less pertinent in connection with small tunnels, than it is with large tunnels. The cost of tunnels in the same formation, with not much difference in size, varies directly as the material moved."

(7098) "MR. McCUTCHEN: You have said that the same unit prices per yard applied pretty generally irrespective of the size of tunnels; do you wish to make any qualification of that?

"MR. DILLMAN: A. Not when you are contrasting very small with very large tunnels, but within a moderate range of size the cost per yard is the most nearly constant way of getting at it, much more so than the cost per lineal foot.

"Q. The cost per yard of running a large tunnel, however, would not be much of an index to the cost of running a small one, would it?

"A. Well, the cost per yard would be increased in the same material for the smaller tunnel.

"Q. And you cannot tell how materially increased?

"A. No. I can estimate it by an examination of the ground satisfactorily to myself and my clients in any given case, but I cannot tell the ultimate fact, no."

This is in marked contrast to Hazen's (6691) and Lippincott's statements that the unit of cost of driving the small tunnel, or pilot tunnel, in the larger railroad work, is much greater than the average cost of the entire final cross section, the expensive part of the work being, according to their experience, incident to the driving of the first hole, which makes the wedging out or release of additional material by blasting very much easier, and somewhat easier, the removal of material from the face of the cut,—considerations which have a vital bearing upon the applicability of railroad tunnel prices to small-bore water works tunnels.

Dockweiler based his estimate substantially upon his study of the records of the company from minute-books upon which he says he spent a month (6752), and from the cost data which he had collected in his office. As previously stated, his own experience had been very limited, and for the most part along the line of mine tunnels, although 23 years ago, when City Engineer of Los Angeles, some sewer tunnels had been driven under his general direction, though his personal contact with them was not close. His point of view is clearly indicated by his comment upon the functions of the engineer in tunnel driving (6737).

"MR. McCUTCHEN: And by that you mean that the engineer in charge of the driving would have to have sufficient experience to handle the tunnel crews properly and use a proper amount of powder?

"MR. DOCKWEILER: A. The engineer would not need to know anything if he had a competent bunch of contractors to drive it and tunnel men who knew their job. If tunnel men know their job the engineer does not help them out much; if they do

not know it you cannot teach a man tunneling; it is too expensive, you had better hire experience rather than buy it."

Dockweiler, too, based his estimate upon hand-drilling in the smaller tunnels and machine work in the larger ones. His estimates were of synthetic type, built up by a consideration of the number of men which he thought might be necessary and which Lippincott with his greater experience thought inadequate (6827).

Difficulties and Hazards of Tunnel Work:

Both Hazen and Lippincott called pointed attention to the greater difficulty and cost per cubic yard of driving the small tunnels as compared with the large, on account of the expense of removing the first or central wedge of material (6631-6691). Dillman, while recognizing this influence, minimizes its extent.

All of the witnesses recognize the influence of the quality, and particularly the hardness of the rock, upon the cost of drilling, blasting, and removing the material. Hazen fittingly described the effect of overbreak upon the amount and cost of placing the concrete lining (6914); the effect of water, or wet sand upon the cost of the work (6931); hazards resulting in deaths (6696-6726); and of other hazards serving merely to increase the cost of the work, as, for instance, in the driving of the Lake Merced tunnel, where an average progress of 6 feet per day was made until they reached a certain point in the tunnel where in a length of 100 feet a wholly disproportionate period of time and expense was involved in overcoming the difficulties encountered (6932).

Lippincott also recognizes these influences (6618) and refers to the necessity for having proper ventilation, equipment, etc., and states that rapidity of construction is essential to low cost in tunnel construction (6612). He calls attention to the hazards and cites the slip in the Bald Hill tunnel of the Spring Valley Water Company, the disastrous experience of the contractor in the building of the Santa Barbara tunnel, and the fact that in the construction of the Los Angeles tunnels from 12 to 20 men were

killed (6848). The figures submitted in Pl. Exh. 143 also gave evidence of heavy ground in the rough timbering or spiling and the crushing of timbers in the Stone Dam, Merced and Davis tunnels.

Dillman thinks that the hazard is less in the small section tunnels (7066), but admits the hazard element and exemplified it by the ups and downs of the men who engaged in it, tunnel-building, referring particularly to the Stone Brothers as examples of men who, though experienced, have not, in his judgment, proven efficient in this field of work, and the Utah Construction Company, on the other hand, which have been most successful in it, as applied to the mining field (7081 et seq.); but in spite of the admission of the existence of serious hazards, by Dillman and Dockweiler, we may hunt in vain for any apparent allowance to cover it in the unit figures adopted by them.

Overbreak in Tunnels:

One of the most important causes of the difference in the estimates of plaintiff's and defendants' engineers upon tunnels arises from the treatment of overbreak, or the material excavated outside of the theoretical lines required by the tunnel lining.

All of the witnesses recognize the existence of overbreak, or, to put it in a different way, the practical impossibility of excavating the material just to the theoretical section or lines required. The amount of overbreak, they say, varies with the character of ground, etc. All admit the paucity of the records relating to the amount of overbreak, and the difficulty of getting such records. The consensus of opinion seems to be that under ordinary circumstances overbreak may increase the excavation by approximately 10%, and Lippincott and Hazen call attention to the fact that this overbreak is likely to increase the amount of masonry required for the lining by 50%, more or less, in excess of the theoretical section.

(6618) "MR. LIPPINCOTT: The things that make for heavy expense in driving tunnels consist, first, of the ground being

badly shattered, or what is termed blocky and heavy ground, with clay seams and well established lines of cleavage. In shooting such ground the powder breaks to the seam and usually not beyond. After the excavation is made, the rock often slips into the tunnel from its place in the sides and roof, making the ground dangerous. Ground of this kind has to be supported with timbers immediately, and owing to crushing they often have to be replaced. It is in this class of material that most of the tunnel accidents occur.

"The rocks of the Peninsula and at Sunol are largely of this class, and while they are intermittently hard and soft, they are full of seams and cleavage lines, and many of these seams are so filled with wet clay that movement of the rock is lubricated. * * * Additional cost is incurred in the timbering. * * * The placing of the timber requires the excavation of a larger section. * * * In lining, this also involves placing a substantially greater amount of concrete to fill all the cavities and spaces between the timber sets."

(6623) Referring to the Los Angeles tunnels:

"In certain tunnels, as I remember it, where we did make a great deal of effort to determine the overbreak, the overbreak was in the neighborhood of 10% as compared with the theoretical excavated section, and of course a very much larger percentage as compared with the concrete section."

(6852) "MR. SEARLS: Have you any particular figures in your mind as to the amount of overbreak that occurs in tunnels of this character?

"A. I have studied that a great deal, yes. I don't know that I would remember all the details of those figures, but in a rock tunnel that is not timbered,—and we are only considering half of the Peninsula tunnels timbered,—it is of course entirely impossible to drive a tunnel true to the line. As Mr. Dillman said this morning, the rock will break to the seam or to the fissure and you will have a jagged and irregular perimeter to your tunnel. Now,

as I remember it, we used to think that we were getting along pretty well if we could drive a tunnel that did not have over from 5 to 10 percentage overbreakage as compared to the yardage in the tunnel section except in the very short sandstone tunnels such as we were discussing this morning where you could trim them with a pick; otherwise you would have perhaps from 5 to 10% overbreakage as compared to the volume of rock excavated. That would very often be 50% of the theoretical concrete yardage; that is, if it took theoretically a yard of concrete to the lineal foot to line a tunnel you would actually put in a yard and a half. That is a very substantial thing to keep in mind."

(6853½) "In the other tunnels we put the regular straight good concrete right back to the limit all around. In the Elizabeth tunnel some of our overbreakage was so severe and so big that we made a special run of very lean concrete to do the back-filling with. Our excess concrete in our tunnels would run about 50% of the theoretical yardage of concrete to line the tunnels."

(Similarly Lippincott 6907; Hazen 6912.)

These were the considerations that led Lippincott to make his estimate of the reproduction cost of the Spring Valley tunnels on the basis per-lineal-foot-of-tunnel in accordance with his established engineering custom, rather than to take the neat quantity schedules in the inventory.

(6659) "MR. SEARLS: Q. Mr. Lippincott, are these cubic yards of excavation taken according to the schedule? Where did you get your figures as to your quantities?

"MR. LIPPINCOTT: A. I took the drawing and made the computations from the drawing.

"Q. Were you not informed that the quantities of excavation had been agreed upon? A. Quantities per foot?

"Q. For the whole tunnel? A. No, I did not know that. As to excavation I have not used any quantity at all. I have just assumed a cost per foot for excavating."

The witness does this in order that the records heretofore kept by him may be correctly used.

Hazen makes clear the greater cost of excavation in the tunnel which is to be lined, resulting from the necessity of adhering, as closely as possible, to the theoretical lines in order to minimize the excess concrete which would otherwise be required to fill the voids outside of the theoretical lines of the masonry lining.

(6913) "MR. McCUTCHEN: Q. So far as the cost of excavating goes, do you assume there is a considerable difference between a tunnel which is to be lined and one which is not to be lined, where it is necessary that the bore of the tunnel be comparatively smooth anyway?

"A. Yes, I think there is a very substantial difference there."

* * *

(6914) "A. My point of view is that to build a lined tunnel 5 or 6 feet in diameter you will get figures representing good careful work ranging all the way from one-third for drifting and two-thirds for lining to two-thirds for drifting and one-third for lining; in other words, you can drift them carefully and get a tunnel that is easily and cheaply lined or you can drift more cheaply and get a drift that it costs a great deal more to line and the end result is the same in either case. Of course, if it is not to be lined, then the cheaper drifting will naturally be selected; so I don't look on the cost of drifting tunnels that are not to be lined as helpful at all in discussing this question except in the most general way."

As to the necessity of backfilling with masonry the cavities caused by the overbreak, Hazen says, in answer to the Master:

(6912) "THE MASTER: Q. Where there is an overbreakage in very hard rock and the tunnel is afterwards filled with cement or brick, Mr. Hazen, is it always requisite to fill up those voids?

"A. It is customary except where there are very large breaks overhead. My experience coincides exactly with Mr. Lippincott's.

If the overbreakage is not too great they put in the ordinary concrete in preference to running a special mix. If there is an occasional hole it is customary to put in plums, put in as many plums as can be put in that space. If there is a considerable space, outside of the regular concrete section, it is customary to mix concrete with about half the usual amount of cement to fill that. I have seen breaks going up 40 or 50 feet; of course it is not feasible to fill that up with concrete. In my experience a break like that has been closed by putting in a layer of concrete perhaps 3 feet thick."

Hazen, too, makes his estimate of the cost of building the tunnel on the per-lineal-foot-basis as more reliable and satisfactory to him than upon the basis of the amount of material to be handled, corresponding to the theortical net section, or neat lines of the tunnel covered in the inventory.

Dillman began by saying that "expert tunnel men would not have any overbreak," but later changed his opinion, denying that he had said so previously, and admitting that overbreak does frequently occur, and may be a very serious factor in cost, one bad break sometimes costing more than the rest of the tunnel, as will be seen by the following excerpts from his testimony: (6798.)

"MR. SEARLS: Q. Mr. Lippincott in his testimony emphasizes to a considerable extent the danger of large overbreak where you have a seamy or blocky material such as he tells us exists on the Peninsula; in your opinion could that be to a considerable extent obviated by careful shooting?

"MR. DILLMAN: A. Expert tunnel men would not have any overbreak there unless they ran into very faulty material, which is not indicated by anything in the country; I have estimated no overbreak beyond what was included in the excavation."

(7060) "MR. DILLMAN: A. I do not know where this agreed inventory was made, but I have accepted the inventory as correct.

"MR. McCUTCHEN: Q. I understood you went further than that; I assumed you assumed that a hole could be driven to the exact size stated in this inventory?

"A. I have not said so, have I?

"Q. Well, do you assume that? A. I do not. * * *"

"A. There naturally would be a little overbreak.

"Q. How much overbreak? A. Not over 10%; my Oakdale tunnels did not go anywhere near 10%.

(It is to be remembered that Dillman stated that the Oakdale material could be whittled with a knife, as can most shale.) (6065.)

"Q. Of the whole excavation? A. Yes, of the neat excavation.

"MR. McCUTCHEN: Q. You said that the overbreak would not exceed 10%? Is that correct?

"A. Yes, sir.

"Q. I understood you to say that on your direct examination, that expert tunnel men would not have any overbreakage at all?

"A. Oh, no, sir.

"Q. You didn't say that? A. No, I could not have said that.

"Q. Unless they ran into faults—you didn't say that on your direct examination? A. I don't think so. I want to take it back if I did. There is hardly any tunnel driven with no overbreak. There is often such little overbreak that it is not paid for.

"Q. What causes overbreakage? A. A rock will not work just to neat lines.

"Q. And no matter with what care the work may be done?

"A. No, sir. * * *

"I think that 10% would be an outside estimate for material of this kind. Of course there are cases where overbreakage is very serious. One spot of overbreak might cost more than the rest of the tunnel."

Dillman shows his lack of experience in water works tunnel construction, and reflects his own railroad tunneling experience. In

his answer to Mr. McCutchen's question as to how he would fill the cavities caused by overbreak, he says:

(6808) "MR. McCUTCHEN: Q. Suppose it were necessary to do some backfilling in tunnels would you consider it advisable to use a concrete mixture for such backfilling?

"MR. DILLMAN: A. No, sir, I have never seen that used. Generally back fill in tunnels is made of loose stuff or cordwood or plunder of that kind."

(7057) "MR. McCUTCHEN: Q. You assumed then, did you, that that tunnel would be so driven as to throw out just exactly the agreed yardage and no more?

"MR. DILLMAN: A. The agreed yardage, yes.

"Q. And no more? A. And no more.

"Q. That is to say, it would have to be that minimum size?

"A. I don't know how this yardage was gotten at. I presume this yardage includes all the overbreak and all the necessary excavation that was done.

"Q. Have you made any figures to know whether that is true?

"A. I have not."

Dockweiler said, with reference to Pilarcitos Tunnel No. 1, "It largely overbroke through the inexperience of the men in handling the powder" (6745). Both statements were, as usual, hearsay, it should be added.

It developed later that Dockweiler would expect some breakage, that overbreakage did occur to some extent, but that he had made no allowance for it (7036).

"MR. McCUTCHEN: Q. Of your own knowledge, then, you know nothing about the overbreakage there [Crystal Springs tunnel] or whether or not there was overbreakage?

"A. I am in the same fix that every other man is who was not in there at the time of the driving.

"Q. What I asked you about was tunnels of your own knowledge. I asked you to tell us what the overbreakage was in your own experience and observation.

"A. I could not recall that; I did not attempt to make any computation on it.

"Q. In your own experience what is normal overbreakage?

"A. I made no deduction.

"Q. My question is, from your own experience what is normal overbreakage? A. I have not recorded my percentages; I have not thought of it in that term at all.

"Q. Would you expect overbreakage? A. Yes, to some extent."

The issue on overbreakage is then a clear one. All of the witnesses recognize that overbreakage is practically inevitable, and that it is only a question of the degree to which it is likely to occur and did occur in these particular structures, and of the extent to which its occurrence would modify the unit prices allowed upon the tunnel excavation. Lippincott and Hazen both recognize overbreakage as an important factor influencing the cost of the tunnel, and make allowance for it in their estimates. Dillman and Dockweiler, on the other hand, while recognizing its occurrence, both admit having made no allowance for it.

Counsel for the defendant insisted:

First, that allowance for overbreakage was included in the inventory;

Second, that even if no allowance was included, the inventoried quantities having been agreed to, should control.

Let us address ourselves to those two propositions.

I shall now quote from the record and I shall try to quote all the discussion which took place upon this subject because of course it is a vital one:

(7057) "MR. DILLMAN: A. I do not know how this yardage was gotten at. I presume this yardage includes all the overbreak, and all the necessary excavation that was done.

"Q. Have you made any figures to know whether that is true?

"A. I have not."

* * * * * * * *

(7058) "MR. SEARLS: I understand that it includes the entire excavation, Mr. McCutchen.

"MR. McCUTCHEN: That is not our understanding. Let us see about that.

"MR. SEARLS: Well, I submit that it is not proper not to consider it so in view of the inventory.

"MR. McCUTCHEN: I do not care to start to argue that with you now, Mr. Searls, but I say it is self-evident and obvious that you have to break out more material than would be in that size hole; in other words, to get a tunnel of that size you must break out a little more material than could be gotten into that hole.

"MR. SEARLS: I submit that it is just another attempt to deviate from the stipulated inventory.

"MR. GREENE: Mr. Searls, the point is this; this shows the amount of minimum yardage that came out of that tunnel as it exists, it is simply the neat section.

"MR. SEARLS: It shows the necessary amount of excavation to be done in the construction of those tunnels,—of course it does."

* * * * * * * *

"MR. SEARLS: I think, your Honor, in fairness to the city, if this stipulation is to be construed in this way we ought to have some knowledge of that before the case is closed so that the computations can be revised. I have understood that our witnesses have understood right along that this was the gross amount of excavation to be done in every case.

"MR. McCUTCHEN: Mr. Searls, how could that be so, for instance, with reference to the concrete filling?

(7059) "MR. SEARLS: Well, I didn't compute your tunnels, Mr. McCutchen, and I don't think there is anything that would put our witnesses on notice that they would have to compute them in the way you are now suggesting.

"MR. McCUTCHEN: Well, the overbreakage could not be computed in the very nature of things; we have not anything to compute it from.

"MR. SEARLS: But your engineers figured all of these matters and these are the agreed quantities.

"MR. GREENE: Will any of your engineers say they computed it in that way, Mr. Searls, when they participated in agreeing on these figures?

"MR. SEARLS: Well, it is agreed on; I don't know how they computed it.

"THE MASTER: Mr. Searls, is the only question at issue whether overbreakage is estimated in these figures here, or is it something else?

"MR. SEARLS: No, your Honor, it is the question as to whether the entire computation of quantities for excavation of tunnels should include an additional amount to the amount given in the inventory and an extra section which would include timbering, if timbering is necessary."

* * *

(7069) "THE MASTER: I am a little doubtful whether to consider there should be overbreakage included in there, or not. I am speaking of the inventory just as it would appear on its face to one who knew nothing about how it was prepared. If Mr. Hazen and Mr. Lippincott have figured the tunnels might include a much larger amount of excavation than that, I think that ought to be made clear. It may be that there might be some further testimony needed as to the way in which this inventory was prepared and figured.

(7070) "MR. GREENE: I want to correct one statement, your Honor, that I made to Mr. Searls this morning, or rather, the statement in one respect, which I have since found out was not the fact, and that is the quantities as given in the inventory represent the amount of the neat section. I find that in the case of one tunnel that that is not so. I am not sure about the others.

I want to withdraw that part of the statement where I stated that as a fact.

"THE MASTER: Well, I would not consider that without testimony to that effect.

"MR. McCUTCHEN: I suppose in the nature of things—I don't know anything about the fact, but I would assume that in the nature of things these quantities were determined from the size of the tunnel as it appeared at the time the inspection was made by those who agreed to the inventory. I take it for granted that none of the people acting for the company, on the one hand, and the city on the other, had any actual information as to what the overbreakage was.

"MR. SEARLS: That is probably true, Mr. McCutchen, but I am informed that in some cases allowance was made for extras and wastage. I asked Major Dockweiler this morning, but he does not recall in this particular instance whether the overbreakage was allowed, or not. I will endeavor to find out from the computation sheets we have what the particular case was in that respect.

"THE MASTER: What is your recollection about it, Mr. Metcalf? Were you responsible for these figures, or was it Mr. Sharon?

"MR. METCALF: Mr. Lawrence agreed with Mr. Dockweiler on the out-of-town tunnels, and Mr. Elliott and one of the city representatives as to the city. I am having the thing definitely looked up now to see what the record shows. It is my understanding, however, that the section is to the outside of the brick work, (7071) with a small margin on the outside, and that that margin has varied with certain of the tunnels. It is also my understanding that in a general way that would correspond to such a line as you might carry, as engineers usually have in specifying tunnel work when it is done by unit quantities; in other words, the drawing shows a certain line to which the quantities shall be measured. If a contractor then finds that the

materials will be greater, he must load his unit prices to provide for that. I should presume the same thing would apply here. We have no definite knowledge, except in a few certain spots, as in the case of the Merced caving ground, whether the actual overbreakage was in those different tunnels. The data is not available. No man can say what it is.

"THE MASTER: What you say explains the doubt I have in reading the schedule. I can conceive, although it never occurred to me before, that the matter of overbreak could be provided for in two ways: one, by adding a percentage to the quantities and then the quantities given would represent the gross required excavation, or the unit cost would be increased by a percentage to take care of overbreak.

"MR. McCUTCHEN: That is just what Mr. Lippincott did, I think. Isn't that what you did, Mr. Lippincott?

"MR. LIPPINCOTT: I would like to state for myself that it was my theory of the computation that the exact dimensions of the tunnel were not so material up to a size of, say, 8 by 8.

"THE MASTER: Yes, I remember that you mentioned 8 by 8.

"MR. LIPPINCOTT: I figured the cost per foot of driving the tunnel, and then I made certain assumptions about the tunnels; I assumed that half the tunnels of the Peninsula were timbered, and figured the cost of timbering half of them.

"MR. GREENE: Would the amount of excavation influence your unit cost one way or the other, Mr. Lippincott?

(7072) "MR. LIPPINCOTT: No, sir.

"THE MASTER: Not up to the amount he mentioned.

"MR. GREENE: How about yours, Mr. Hazen, would the amount of excavation influence your net cost one way or the other up to the size tunnel which you figured as the economical one to drive?

"MR. HAZEN: No, it would not affect it.

"MR. SEARLS: On the other hand, our witnesses figured it, on the basis of cubic yard, which was the unit given in the in-

ventory, and, manifestly, the total quantity there is an important factor.

"MR. McCUTCHEN: They originally determined the cost on a cubic yard basis?

"MR. SEARLS: Yes, I don't know, though, as to Mr. Dillman. I think you did figure it per foot, didn't you, Mr. Dillman?

"MR. DILLMAN: No, a cubic yard basis.

"THE MASTER: To use Mr. Metcalf's phrase, did you load your unit price, or your quantity, for any overbreakage?

"MR. DILLMAN: Neither one. I take it that these quantities are included in the inventory. They should be. And any inventory to be correct, should also include the timbering. That is the reason I have not figured any timber here.

"THE MASTER: What did you do, Mr. Dockweiler?

"MR. DOCKWEILER: That question came up at the time. No one was sure—at least, Mr. Lawrence could not tell us how much timber there was in each one of the tunnels, so we omitted the amount of timber. Then we decided to give the length of the tunnel, and also the cubic yardage, and estimating from the best of our knowledge what would be termed a safe section. Several of these tunnels vary. One of the tunnels was timbered, and then the concrete or brick work was placed inside the timbers. Now, in that tunnel, we figured the yardage to be outside the timbering. We had quite a lot of discussion about that.

(7073) "MR. LIPPINCOTT: What tunnel was that, Mr. Dockweiler?

"MR. DOCKWEILER: I think that was the No. 2. I don't remember. Mr. Lawrence and myself finally concluded we would put it in in two ways, by the lineal foot and by the yardage, and then each engineer figuring could determine for himself. The difference in the yardage per lineal foot would give the party estimating a clue as to the form of the lining employed.

"MR. McCUTCHEN: The yardage was not intended to be controlling, then?

"MR. DOCKWEILER: The yardage was to be controlling as to such a section that the contractor would be paid for. I think we aimed to get at that, after a considerable lot of discussion. I cited to Mr. Lawrence at the time the Stone Dam Aqueduct No. 1, where I told him that the timbers had been pulled out as the tunnel was bricked. We will have to refer to the notes. I think if Mr. Lawrence and I got together with those numerous notes which we made, that, between the two of us, we could get at what we intended at the time."

* * *

(7171) "MR. SEARLS: On this tunnel business, I would like to make sure that the question is understood by his Honor. I would like to direct to Mr. Dockweiler the question that I directed to Mr. Hazen.

"MR. GREENE: Might it not be well to have the Reporter read to us what Mr. Hazen said and see whether it is satisfactory to Mr. Dockweiler?

"MR. SEARLS: Very well."

I will read here what Mr. Hazen said because it was read from the record:

"MR. HAZEN: The understanding that I have from talking with Mr. Dockweiler and Mr. Lawrence is that the figures in the agreed inventory are to be accepted as the section that might reasonably or probably would be specified if bids were to be obtained for driving the tunnels on a yardage basis and that all excavation outside those lines would be at the contractor's risk and expense.

"MR. DOCKWEILER: That would be a fair statement. That is the area I should specify in making a drawing. If you were working in a formation something like cheese that would be all that you would cut out."

It seems to me, your Honor, that gives the answer to the whole problem.

"MR. SEARLS: How did you take care of overbreak in your appraisal, Mr. Dockweiler?

"MR. DOCKWEILER: A. I assumed that the tunnel would be driven at so much per foot, and I divided that cost per foot by the yardage stipulated in the schedule per lineal foot, and thus determined my price of driving per cubic yard; so that my price of driving per lineal foot automatically cares for the overbreak, whatever that may be. I do not allow any fixed percentage for overbreak.

"THE MASTER: As I understand Mr. Dillman's figures he considers that the inventory figures as to yardage include any overbreak that there will be.

"MR. SEARLS: I think that is true, but at the same time he reached his conclusions on a basis of driving per foot. While I have not discussed the matter with him at all, I would like to know whether he included it or whether it should be added to his unit costs."

Later Lawrence testified that the excavation quantities were figured for the tunnels on the basis of the neat sections, and did not include allowance for overbreakage.

(7154) "THE MASTER: Q. In other words, on that basis the cost of overbreakage would have to be reflected in the units?

"MR. HAZEN: A. Yes.

"MR. GREENE: Q. As I understand that is practically in accord with what you said yesterday, Mr. Metcalf?

"MR. METCALF: Yes."

* * *

(11,081) "MR. GREENE: Q. Was there any allowance made in the ascertainment of these quantities for waste or were the quantities net quantities?

"MR. LAWRENCE: A. Net quantities.

(11,082) "MR. SEARLS: Q. Who was it that worked with you upon the City's side?

"MR. LAWRENCE: A. Mr. Noble.

"Q. Did Mr. Dockweiler himself work with you at any time?

"A. He was there very little on that part of it, the checking up part of it."

* * *

(11,045) "MR. GREENE: Q. Did you have anything to do with the preparation of the inventory?

"MR. ELLIOTT: A. The inventory of all the properties in San Francisco were made jointly by Mr. Stocker, for the City of San Francisco, and myself for the Spring Valley Water Company, and in no case did we include in the inventory any allowance for waste of any kind whatever. All of the quantities in there were unit quantities, as actually measured in the structures."

We submit therefore, first, that it is clear from the record, that allowance was not made for overbreakage, in the agreed inventory, but that, on the contrary, the quantities therein contained are to the neat or theoretical tunnel sections; and second, that allowance to cover overbreakage should have been made by the witnesses in their unit figures for tunnel excavation and tunnel lining, in accord with current engineering practice, as admitted by Dockweiler, as well as by Lippincott and Hazen.

The plaintiff's engineers made such allowance; we find none in the defendants' estimates.

MR. SEARLS: Mr. Dockweiler testified there that he did.

MR. GREENE: I think if you will examine his testimony in detail you will find some difficulty in finding where he made any allowance for overbreakage. That would be a good point for you to consider in your argument, Mr. Searls.

The effect of allowance for this overbreakage, on the part of the defendants' engineers, would be to substantially increase their estimated unit costs,—first, in the allowance for the amount of the excavation, which all of the engineers agree would probably have been in the neighborhood of 10% and in the unit cost thereof, due to the greater care required to keep the overbreakage within

this 10% limit; second, in the cost of the concrete lining, by reason of the increase in quantity required, which the engineers for the plaintiff said would be likely to amout to 50% of the theoretical masonry lining requirements. It is safe to say that allowance by the defendant engineers for this factor alone would have increased their estimates per-lineal-foot of tunnel by a very substantial amount.

Lippincott says (6630-6690) that the economical limit for driving is 8 by 8 feet, or, in other words, that there is no economy in attempting to drive a section smaller than that because of the increase in cost per cubic yard of handling the material, resulting from the smaller section and cramped quarters. He says that this section is practically equivalent to 6 feet in the clear after lining.

Hazen comes (6693-6719) to practically the same conclusion, which, however, he puts differently, referring to the minimum internal diameter of the finished masonry section of the lined tunnel, which he fixed at between 5 and 6 feet, corresponding to an approximate drifting section of from 8 by 7 to 8 by 8 feet.

While Dillman thinks that (7075) "if the tunnel that was actually needed was a very small, uneven size and shape to work in, yes, it could probably be excavated larger with no greater cost per lineal foot," and says that "if you have a tunnel, say 5 feet wide by 7 feet high, there is no possible advantage in enlarging the section to cheapen the cost per lineal foot," it is yet to be noted that he fixes his unit price upon the basis of unlined tunnels of larger section, without increasing them when he applies them to the smaller tunnels, which cannot be so economically driven because of the cramped quarters. The practical effect of this is to substantially reduce the amount of his estimate.

Prices Assumed for Materials:

Lippincott assumes the following basic prices: Cement f. o. b. cars, $2.10 (6892), referring to his broad experience in different parts of the state for a considerable number of years, and to the

fact that he paid $2.10 for cement in Santa Barbara in the year 1913, and that the Spring Valley paid $2.13 per barrel at Milpitas in the same year. For sand he allows 85c per ton at the pit, and $1.10 per cubic yard f. o. b. cars, basing his estimate upon an approximate weight of 2700 pounds per cubic yard, dry, or 3000 pounds wet (6640; 6893-4). He states further that dune sand was not, and should not be used, being inferior to bank sand for engineering work. (6894). For the hauling Lippincott allowed prices varying from 35c to 45c per ton mile; upon the brick $6.50 per thousand, plus $1.00 for delivery, or a total net price, f. o. b. cars, of $7.50, with additional allowance for hauling of 40c per ton mile and for handling $1.25 per thousand; for placing the brick work $17 per thousand, making his total cost per thousand for the brick, delivered and placed in the tunnel, from $26.42 to $34.75, averaging about $30 per thousand.

With regard to brick he subsequently stated that he thought his price was perhaps 50c per thousand too high, which would have the effect of reducing the cost of his brickwork figures by 25c per cubic yard, or 10c per lineal foot of tunnel (6889). It ought to be borne in mind that the costs for hauling here are not fairly comparable to the costs for hauling to the Crystal Springs dam which we will consider in detail in the next part of our argument.

For the lumber Lippincott allows $17 per thousand f. o. b. cars, to which he adds the cost of hauling at 40c per ton mile, and handling at 25c per thousand feet board measure. For the labor of placing $20 per thousand, making his total allowance for the timber in place from $37.69 to $43.19, averaging perhaps $40.

For the rock used in making the concrete, he allows $1 per cubic yard, plus hauling figured at 35c to 40c per ton mile, making the cost of the rock, delivered, from $1.50 to $3 per cubic yard.

Lippincott assumed proportion of 1:3:6, although the mixture

actually used was somewhat richer, or a proportion of about 1:2:5, and for some of the concrete used in backfilling he allowed a very lean mixture of 1:6:12. For the mixing and placing of the concrete, from $2 to $2.50, and to the resulting cost per foot of mixing and placing the concrete he added, in accordance with his experience and practice, 40% indirect costs.

Applying these unit figures to the concrete, Lippincott arrived at the following prices per cubic yard in place, shown in

Table 21

Bald Hill Tunnel	$11.85 per c.y.
Davis Tunnel	11.63 "
Pilarcitos No. 1	13.41 "
Pilarcitos No. 2	13.75 "
Stone Dam Tunnel No. 1	14.28 "
Stone Dam Tunnel No. 2	13.78 "
Crystal Springs Tunnel No. 1	10.09 "
Crystal Springs Tunnel No. 2	10.99 "
San Andreas Waste Tunnel	11.40 "

The above figures result in prices, for concrete per-lineal-foot-of-tunnel, varying from $10.26 for the San Andreas wasteway, to $12.26 for the Stone Dam Tunnel No. 2, and for the back-filling from $2.59 to $3.83 per lineal foot.

Lippincott found, in general, that the cost of the brick lining would be substantially greater than that for masonry, varying from $4.82 per lineal foot on Bald Hill Tunnel, to $7.14 per lineal foot on Pilarcitos No. 1, and being $12.52 and $13.58 per lineal foot upon San Andreas wasteway and Pilarcitos No. 2.

THE MASTER: By masonry you mean concrete?

MR. GREENE: By masonry I mean concrete as distinguished from the brick work.

Upon the excavation per lineal foot of tunnel Lippincott figured $16.80, and for the wasteways $19.60; for the timber from

$1.16 to $2.64; giving a combined average of $19.04 (not weighted) per lineal foot of tunnel, on the several tunnels built by the Spring Valley Water Company.

Hazen, as previously stated, did not make a synthetic cost estimate for these tunnels, but based his estimate upon the actual cost figures and comparative figures developed in many other places, all, however, upon a per-lineal-foot basis. In his testimony upon the construction of the Crystal Springs dam, he used figures in close accord with those adopted by Lippincott for cement, sand, gravel and brickwork, and finally arrived at tunnel costs remarkably close to the latter's, although the two estimates were made quite independently, without any knowledge on the part of one engineer of the figures arrived at by the other.

Dockweiler used similar figures upon the sand, 85c at Niles and $1.02 at Millbrae, on the weight basis of 2700 pounds per cubic yard (6767). The figures used by Dockweiler upon the concrete were substantially lower than Lippincott's and Hazen's, resulting from a lower assumed price per barrel of cement, a substantially smaller allowance for the labor of mixing and placing, and lower indirect or auxiliary costs.

While Dockweiler, Defendants' Ex. 141, does not make clear the base price allowed by him upon the cement, it is to be presumed that it was the same as that used in his Defendants' Ex. 142 upon brickwork, exclusive of tunnel lining, in which he allowed for the cement, prices varying from $1.81 to $1.91 per barrel f. o. b. cars, at various delivery points on the work.

Dockweiler's allowance for the concrete tunnel linings are based upon a price of $9 per cubic yard for the concrete furnished and laid, with the exception of the stone dam aqueduct tunnel for which he assumes $9.50. These prices, comparable with Lippincott's average figure of $12.35 per cubic yard, are equivalent of varying rates from $8.30 to $11.78 per foot for the concrete in place.

Upon the brickwork Dockweiler's figures vary from $28 to

$36 per thousand furnished and laid, with the exception of the Pilarcitos dam and aqueduct tunnels Nos. 1 and 2, and stone dam aqueduct tunnel No. 1 upon which he used higher figures varying from $52.50 to $57.50 per thousand, making his allowance for brickwork per foot from $5.76 to $7.81, with the three exceptions noted, which vary from $11.01 to $11.42.

Upon the cost of driving, however, Dockweiler's figures are substantially less than those of Lippincott, averaging $10.89 per lineal foot (not weighted), a little over one-half of Lippincott's average price of excavation (not weighted), $17.36 excluding timbering, or $19 per lineal foot including timbering.

Dillman bases his excavation figures upon a general unit price figured on the net section of $4 per cubic yard (which he says must include allowance for timber, care of water, drainage of shafts, etc.) which applied to the average section, of 1.7 cubic yards more or less, amounts to a little less than $7 per lineal foot, being substantially below Dockweiler's figures and less than one-half of Lippincott's.

The brick lining Dillman figures generally at $25, and in some cases $30 per thousand (6801), not, as he says, because he has had any experience, but because this is equivalent to an allowance of $12.50 per cubic yard for concrete, which would more than line the tunnel (6801; 6805-8), whereas defendants' other witnesses, Phillips and Dockweiler, allow $36 per thousand.

Upon the concrete lining Dillman allows but $10 per cubic yard, applied to the net section, without allowance for overbreak (6801). He does this principally upon the strength of his first erroneous impression that that was the price at which the Oakdale irrigation tunnels, referred to by him, were being lined, by Edward Malley, although he subsequently admitted he had been mistaken in his understanding as to what this figure covered, and that the actual cost was much greater. He did not modify his figure, however, but attempted to explain this increase in a manner which speaks for itself (7051).

"MR. McCUTCHEN: Q. Did you use the costs of the tunnels in the Oakdale district as a guide in fixing the cost of running these tunnels that we are considering here?

"MR. DILLMAN: A. I think I did in a certain measure."

* * *

(7086) "MR. DILLMAN: I have not related any estimate on these tunnels directly to any one tunnel or any one set of tunnels as closely as to the Oakdale work with which I was recently connected; it went on during the time that this work is supposed to have been done; it was finished in 1913. I knew more of the main facts then than of the collateral facts and conditions there. They were small tunnels. Therefore I considered them more pertinent than any other information."

* * *

(6792) "MR. DILLMAN: This tunnel [referring to the Oakdale tunnel] is now being lined by Edward Malley, contractor of San Francisco, at cost plus a percentage, but with a guarantee that the lining will not exceed $12 a cubic yard.

"THE MASTER: Q. Lined with concrete? A. Yes."

* * *

(7376) "MR. DILLMAN: As regards the concrete lining of the tunnel which is going on, that came to me in a telephonic conversation. My price is right. The contract price is cost plus a percentage, which is not to exceed $12. I asked what the contractor furnished, and the answer was 'Everything.' The contractor does not furnish everything; he does not furnish the gravel, he does not furnish the cement; he does all the labor and furnishes the lumber. What that will cost is unknown to me; it is unknown to anybody yet, because the contract is not through. The contractor's statement to me on Saturday was that his work would cost something in the neighborhood of $10. To that should be added the cost of gravel and cement.

"MR. McCUTCHEN: Q. $10 for what?

"A. $10 for the forms, and the labor of putting it in—everything except the sand, and gravel and cement. By the way, that is a gravel mix, also; it is gravel from a bar on the river that is hauled to the place."

Note the later statement. The concrete is not made by providing separately sand and gravel and mixing them together, after the addition of cement, but is simply taken out of the bed of the stream, the run of the bank, so to speak, which in itself would effect an important saving to the contractor.

"THE MASTER: Q. It was cost, plus percentage, was it, not to exceed $12?

"MR. DILLMAN: A. Those are prices that I cited as corroborative, your Honor, they were not used directly in deducing any of my prices; but they should be corrected because they are wrong."

* * *

(7382-4) "MR. McCUTCHEN: Q. Suppose you took the cost of cement there at its cost here in San Francisco, and you took the sand and gravel there at what you would assume it to cost on any of these pieces of work here, tell us what would be, in your opinion,—leaving out the lumber now for a moment—tell us what, in your opinion, would be the cost per cubic yard of that concrete lining at Oakdale?

"MR. DILLMAN: A. From $10 to $12 a cubic yard.

"Q. But the contractor tells you that it will cost him about $10, and after that you must add the cost of the cement and the cost of the sand and gravel, must you not? A. Yes.

"Q. Approximately what will that add per cubic yard, in your opinion at prices for cement and sand and gravel similar to those that would obtain in San Francisco? A. $4 or $5.

"Q. That would be about, at a minimum, $15 per cubic yard, would it not? A. $14 or $15.

"Q. And that, of course, is on a basis of a ten-hour day—they work their men 10 hours, don't they?

"A. I think so, I don't know.

"Q. For that change in conditions, would you make any allowance? A. This tunnel that is being lined there is not being lined throughout. It is a very long tunnel, and it is only a few hundred feet, I think less than 1000 feet, somewhere near the middle of the tunnel and this material has to be taken in through a shaft and then taken in cars from the bottom of the shaft to the places of application. That tunnel lining should cost more per cubic yard under exactly similar conditions otherwise so far as cost of material goes, than it would here.

"Q. That lining, on the basis of cement cost and sand and gravel costs, identical with those that would obtain in San Francisco, and taking into consideration the difference in hours would cost quite $20 per cubic yard, would it not? A. No, I had not assumed there is any difference in hours.

"Q. You know there is, though, don't you? A. No.

"Q. How long would you work your men here in San Francisco?

"A. I would certainly work them nine hours, and I don't know that they work them any more there.

"Q. I understood you to say just now they worked them ten.

"A. I said I did not know.

"Q. What was your experience in conducting your work. Didn't you always work your men ten hours?

"A. Yes, sometimes fourteen.

"Q. When a man came on the job and wanted to know the hours, what did you tell him he was to do, work 8, or 9 or 10 hours? A. I had no charge of the contractor's force there; I think they worked 10 hours.

"Q. Have you any doubt about that? A. Yes, I have.

"Q. Don't you know that was the uniform practice, for them to work their men ten hours?

"A. I think very likely, but that particular tunnel work, you understand, was done not by the day, at all.

"Q. It was done by contract, but the contractor worked his men 10 hours? A. The contractors were the men that worked right there.

"THE MASTER: Station men, he called them.

"A. Station men.

"MR. McCUTCHEN: Q. They did not hire any men? A. No.

"Q. That is, the contractors who did this concreting, did not hire any men? A. The station men were contractors.

"THE MASTER: They were sub-contractors.

"MR. McCUTCHEN: They did not employ any men to work for them? A. No.

"Q. You are quite sure of that?

"A. As a rule, I know they did not.

"Q. Do you know anything about that personally? A. Yes, I do.

"Q. Did you ever see the work going on? A. Many times.

"Q. How many of these contractors were there?

"A. There were eight or ten in a camp.

"Q. I am talking of this concrete work, not of the driving of the tunnel.

"A. I have not done any concrete work.

"Q. But you have told us about some concrete work being done there now, haven't you? A. Yes.

"Q. Is that being done by a contractor?

"A. You were asking me about the time they worked there. I don't know how long this contractor worked his men. His name is Malley; he lives in town; I can find out by telephone.

"Q. Edward Malley? A. Yes, a well-known contractor."

We submit that on Dillman's own statement of the facts, fairly applied, the cost of the Oakdale tunnel lining may lie between the figures of $17 and $20 per cubic yard, as shown by Table 22.

Table 22.

	Minimum	Maximum
Labor including lumber (Malley)	$10	$12
Cement and Sand (Dillman)	4	5
	$14	$17
Correction for 8-hour day (upon tunnels as compared with 10-hour day) say at least 20% addition	2.80	3.40
	$16.80	$20.40

These figures corroborate in a striking manner the basic computations of Lippincott, and when they are coupled with Dillman's failure to make any allowance for excess material required to fill the cavities left by over-breakage, show the total inadequacy of his computations and of his application, to the estimates in hand, of his basic data which he considers particularly significant.

Let us see, however, how Dillman himself, meets his discovery. Witness his mental candor and fairness.

(7386) "MR. McCUTCHEN: Q. You still think, notwithstanding what you have since learned of Mr. Malley's contract, that this company [referring to the Spring Valley Water Company] would be very fairly treated if it were allowed $10 a yard for lining the Sunol tunnel?

"A. Yes, I think it could be lined for that.

"Q. $10 a yard? What were your figures on the cost of driving and lining the Sunol tunnels?

"A. I figured about $18.53 a lineal foot."

(His final figures corrected for timbering run from $20.32 to $24.62 per lineal foot, as compared with Lippincott's figures of $29.06 to $31.88 for Tunnels 1 to 4 inclusive, and $13 for Tunnel No. 5, and Hazen's $25 to $33 upon Tunnels No. 1 to 4, and $14 on Tunnel No. 5.)

"Q. That is for the driving and lining? A. Yes.

"Q. How much of that have you allowed for lining, that is, per cubic yard, or per lineal foot?

"A. Per lineal foot; I allow $10 a cubic yard for concrete lining.

"Q. Now, is it fair to say that is just about one-half of the cost on the Oakdale tunnel which is now being done by Mr. Malley? A. No.

"Q. What percentage is it of his costs, as you figure them?

"A. Well, taking his statements of what it will cost, and the work isn't done yet, at $10, and adding the cost of city prices for other material, making a deduction for the average prices of lumber down there, which Mr. Malley furnishes, his price will not be three-quarters of $20."

* * * * * * *

"Q. Now, do you say, resolving that into an eight-hour day, and allowing for cement, and sand, and gravel, what you would be compelled to pay for them (7387) here, that he is not getting three-quarters of $20, or that the work is not costing three-quarters of $20? A. No.

"Q. Does that $10 include his profit, or is that upon which he is to get a percentage? A. The $10 includes his percentage and all."

* * * * * * *

"MR. DILLMAN: I have not gone into this analysis, and I know as much about the cost of concrete work as I do about the different details of it, and probably more."

* * * * * * *

(7388) "MR. McCUTCHEN: I want to see if we cannot make a comparison of your figures on that with this Oakdale work.

"A. I did not use that Oakdale work; I did not know anything about that Oakdale work until my estimate was done.

"Q. You cited that, didn't you, on your direct examination?

"A. I cited that as corroborative evidence. That work did not cost as much as my estimate.

"Q. Do you think that it does corroborate your estimate?

"A. Not as well as it did before I got these additional facts.

"Q. To be perfectly candid, Mr. Dillman, don't you think that it has just the opposite effect, and that it does not corroborate your estimate, that it has a tendency to show your estimate as too low?

"A. I think in the light of recent investigations and inquiries that $10 is a good deal closer price than I thought it was when I made it; I am not sure but what I would make it $11 or $12 today; but I should not make it $15 under any evidence that I have.

"Q. Why do you think you would make it, or might make it $11 or $12 today?

"A. Simply because I have been inquiring, and believe, and a large part of my information has come from the testimony in this case, I am convinced that $10 is a pretty tight price. I am also satisfied that I could let it today for $10. Whether I could get the good job done that I would want done for that, I am a little bit in doubt."

* * * * * * *

"Q. Now, coming back to the question I asked you a few moments ago, are you not inclined to think that this Malley work indicates quite conclusively that your figure on the concrete work on the Spring Valley tunnels is altogether too low?

"A. No. If it fixes anything in my mind, it is that they have let this contract to Malley at too high a figure."

It is unnecessary to quote further from the colloquy between cross-examining counsel and Dillman. Can there be doubt that in the bottom of his heart Dillman knew, as a result of his further conference with Malley, that his figures were too low, and that he was taking the indefensible position of trying to sustain his original figures when he was fully convinced they were wrong?

J. J. Phillips, witness for the defendant, gave testimony concerning the cost of brickwork which corroborated Hazen's estimates, and proved the inadequacy of Dillman's, and to a less extent those of Dockweiler. Phillips said that masons earned $7 per day of 8 hours, that as a rule work was a little cheaper in the city of San Francisco than in the country (7533); that upon the Merced culvert the masons would lay from 800 to 1200 brick per day, and that $25 per thousand was a fair allowance for them in place (7537); that upon the tunnels the masons would lay about 500 brick per day at a cost of about $36 per thousand furnished and laid (7537); and that upon two stacks which he had built the masons had laid about 1200 brick per day,—perhaps sometimes 1500 to 1800 (7550); and finally that is was not nearly as easy to lay brick in Portland cement mortar as in lime mortar, that it would keep a man busy to lay 1,000 brick a day in sand and cement and mortar, where he could lay 2,000 brick in lime mortar (7554).

Thus were the figures of the plaintiff upon brickwork absolutely substantiated by the city's own witness of greatest experience in such matters.

He was a man of 37, resident of San Francisco, one time president of the Bricklayers' Union, employed by the City and County of San Francisco as a building appraiser, right-of-way agent and building inspector (during the period from 1907 to 1913), associated with the firm of Rainey & Phillips, which specialize on brick construction, and which had constructed probably from 400 to 500 buildings in San Francisco since 1902, and had done work for various public utilities.

MR. SEARLS: Will you explain how they are substantiated?

MR. GREENE: You will find his estimates on the Merced and Crystal Springs tunnels check almost exactly the figures which Mr. Hazen used on his brick work in these two places.

I will first quote from page 7548:

"MR. GREENE: Q. What have you got to say of the char-

acter of construction of the drainage tunnel at Merced: is that good brick or bad brick? A. That is a very good job, yes.

"MR HAZEN: Is that on page 208, structure 5, Mr. Searls?

"MR. SEARLS: The drainage culvert, Mr. Hazen.

"THE MASTER: There are several of those out there, Mr. Searls.

"MR. SEARLS: It runs from the settling basin at Merced out to the tunnel, there.

"MR. HAZEN: Structure 6, I think.

"THE MASTER: Mr. Hazen, what is that structure that runs west from the dam, the small dam at the end of the south lake—that is the Lake Merced tunnel, isn't it?

"MR. HAZEN: Through the hills?

"THE MASTER: It is visible there as you cross the clay dam at the end of the south lake.

"MR. GREENE: That is part of the drainage system.

"THE MASTER: Is that the Lake Merced tunnel?

"MR. ELLIOTT: That is the tunnel that leads out of the end of it.

"THE MASTER: Lake Merced tunnel is under the bluff, is it?

"MR. ELLIOTT: Yes.

"THE MASTER: The Colma brick drainage conduit; is that the one that I referred to?

"MR. HAZEN: That is the open structure.

"MR. ELLIOTT: Yes, that is the one.

"MR. HAZEN: That is the one that the witness is speaking of, the open one.

"A. It is the open structure.

"THE MASTER: Right at the end of the lake?

"A. It is to the east of the lakes.

"MR. HAZEN: That is what you estimated at $25? A. Yes.

"MR. HAZEN: I estimated that at $30. A. That is not bad.

"THE MASTER: Perhaps while we are at it, we can identify the Crystal Springs structure.

"MR. HAZEN: Is the structure referred to, that on page 26, the outlet tunnel, structure 5? I speak of that because it is the only one that anyone can get into, as far as I know. That seems to be structure 5, and the estimate on that is $36 a thousand. My estimate is $30.

"THE MASTER: Is that right, structure 5?

"MR. SEARLS: That is the structure at Crystal Springs.

"THE MASTER: Mr. Hazen is $36 on the gate tower.

"A. The gate tower I certainly would put lower."

Now, there are three structures referred to, the first of which Mr. Phillips estimated lower than Mr. Hazen by $5, the other of which he estimated higher than Mr. Hazen by $6, and the third one—as to that we have the statement that he would put it lower but he does not say how much lower. Those are the only structures which I have been able to ascertain from the record that Mr. Phillips estimated.

MR. SEARLS: That is my understanding of the testimony, Mr. Greene, but I did not understand your conclusions from it.

MR. GREENE: I now quote from page 7553-4, and this bears on the question of the use of cement mortar or lime mortar, Hazen having testified that the mortar used in the structures of the water company was all cement mortar without the use of lime:

"MR. HAZEN: Q. Is it as easy to lay a brick in Portland cement as in mortar? A. No, Portland cement is much more difficult.

"Q. What would be the comparative rate at which you would proceed? A. It is hard to say.

"Q. Would it be 50%? A. I would not be surprised.

"Q. That is, the lime helped that much? A. If you can put a small percentage of lime in the mortar, you can do better work; I consider a man can do better work than he can in sand and cement, though engineers insist on doing it.

"MR. GREENE: Q. If you had your mortar with a little lime in it, such as you speak of, do you mean that a man could lay twice the amount in cement mortar? A. I have seen it—

"Q. (Intg.) That would be your estimate? I am trying to get a meaning to 50%. A. For instance, in sand and cement without any lime at all, it keeps a man busy to put in a thousand in a day, where he would put in 2000 with lime."

THE MASTER: There is nothing to indicate whether Mr. Phillips' figures on the structures you have referred to are rated on the basis of cement mortar or mortar with lime in it?

MR. GREENE: There is nothing so far as I can say, your Honor, although I would say that the presumption was probable from his testimony on that subject that he was making a figure on the basis of his normal work and experience and that that was the mortar with lime in it.

MR. SEARLS: I thought that he was estimating the job that he saw there; whether he understood the brick was laid with cement mortar, or not, I do not know.

MR. GREENE: I agree with you there, Mr. Searls; I simply voiced the assumption that I would assume he was dealing with work which he himself had done.

MR. GREENE: I will now present your Honor with tabulation 23.

[Table inserted opposite]

This tabulation is entirely clear. It gives the estimates of Hazen, Lippincott, Dockweiler and Dillman, showing the different tunnels by name, the place where they are found in the inventory, their length in feet, the unit cost applied and the amount. Your Honor will observe that Hazen's estimate is $1,124,095; Lippincott's, $1,100,757; Dockweiler's, $833,965 and Dillman's $650,183.

I now have some comparable tunnel data that is submitted by the different witnesses, and which I have had copied, as I think it will be easier to follow. I will present that now. The tables are numbered 24 to 27. [Tables inserted opposite]

Table 23.

COMPARISON OF GROSS REPRODUCTION COST ESTIMATES UPON TUNNELS

Exclusive of Overhead and Interest-during-Construction.
As of Dec. 31, 1913.

Page	Inventory Structure No.	Name of Structure	Length in ft.	Hazen		Lippincott		Dockweiler		Dillman	
				Unit per ft.	Amount	Unit per ft.	Amount	Unit per ft.	Amount	Unit per ft.	Amount
3	17	Pilarcitos Tunnel #1	1,495	$27.50	$41,113	$27.31	$40,828	$20.92	$31,285	$11.12	$16,680
3	18	Pilarcitos Tunnel #2	3,426	27.50	94,215	28.15	96,442	22.09	75,680	11.12	38,097
7	8	Stone Dam Aqueduct #1	3,201.5	27.00	86,441	27.63	88,457	22.42	71,778	11.04	35,345
9	1	Stone Dam Aqueduct #2	3,530	29.00	102,370	30.46	107,524	20.05	70,777	16.59	58,563
16	1	Davis Tunnel	1,205	30.00	36,150	28.90	34,824	21.05	25,365	17.49	21,075
21	10	Bald Hill Tunnel	2,820	27.00	76,140	25.36	71,515	17.77	50,111	10.88	30,682
33	3	Crystal Springs Pipe Line Tunnel #1	301	24.10	7,248	24.96	7,513	12.09	3,639	12.05	3,627
33	3	Crystal Springs P. L. Tunnel #2	2,144	28.00	60,032	25.31	54,265	18.02	38,644	12.05	25,835
			18,122.5	$27.80	$503,709	$27.67	$501,368	$20.27	$367,279	$12.68	$229,904
76	1	Sunol Aqueduct Tunnel #1	7,502.5	$31.00	$232,578	$29.06	$218,008	$24.10	$180,820	$20.87	$156,577
	2	Sunol Aqueduct Tunnel #2	856	31.00	26,536	31.88	27,289	26.78	22,920	24.62	21,075
	3	Sunol Aqueduct Tunnel #3	1,576.2	33.00	52,015	29.06	45,798	23.87	37,620	20.34	32,060
	4	Sunol Aqueduct Tunnel #4	2,840	25.00	71,000	29.06	82,530	23.85	67,737	20.32	57,709
	5	Sunol Aqueduct Tunnel #5	1,789.4	14.00	25,052	13.00	23,257	10.12	18,112	21.50	38,472
			14,564.1	$27.95	$407,181	$27.25	$396,882	$22.45	$327,209	$21.00	$305,893
208	5	Lake Merced Tunnel	3,036	35.00	106,260	39.59	120,195	27.49	83,460	23.15	70,289
318	23	Lake Honda Tunnel	2,820	26.00	73,320	17.37	48,983	11.62	32,761	10.00	28,193
337	3	Bernal Tunnel	1,345	25.00	33,625	24.78	33,329	17.29	23,256	11.82	15,904
			7,201	$29.61	$213,205	$28.12	$202,507	$19.37	$139,477	$15.88	$114,386
		Grand Total	39,887.6	$28.18	$1,124,095	$27.60	$1,100,757	$20.91	$833,965	$16.30	$650,183

Table 24

COMPARABLE TUNNEL DATA

J. B. Lippincott, (Pl. Exh. 133, page 7), submitted the following data with the comment,

(6624) "The thing I have endeavored to do with these tunnels is to pick out tunnels that somewhat approximate "in the character of the material, the tunnels we have had to do with on the Peninsula. We have had very "much harder tunnels and we have had very much more expensive tunnels in cost per foot, but these tunnels "somewhat approximate the conditions on the Peninsula."

Record Page	Location	Direct costs per-lineal foot	Direct and Auxiliary Cost-per-lineal-foot excl. Company's Administration, Engineering and Overhead Expenses
6621	Los Angeles Tunnel # 6	$22.29	$29.94
6622	" " " 28	22.46	29.71
6625	" " " 9	20.97	28.64
6626	" " " 35	31.91	42.21
6627	" " " 38	35.51	46.98
6629	Santa Barbara Tunnel		39.40
Pl. Exh. 133 p. 29a	Oahu, H. 1		32.55

Spring Valley Tunnels: Allen Hazen Pl. Exh. 139

First Period	Approximate date of Construction	Length in feet	Diameter of circle of equal area	Approximate cost per ft. according to old records
Honda	1868	2,820	3.4	$17.10
Bald Hill	1870	2,820	3.8	17.00
Pilarcitos #1	1871	1,495	4.2	25.90
" #2	1871	3,426	4.2	21.50
Stone Dam #1	1872	3,201	3.9	13.20 #
Average of 5			3.9	$18.94

Reputed cost clearly does not include all items and is (6720) too low. (Hazen states that the true cost was probably nearer $20.00 per lineal foot, and that this amount brought down to date is approximately $26 to $27.50.

Second Period	Approximate date of Construction	Length in feet	Diameter of circle of equal area
Crystal Springs #2	1885	2,144	4.5
Third Period			
Stone Dam No. 2	1897	3,530	4.7
Davis Tunnel	1898	1,205	4.9
Sunol Tunnel	1900 About	11,662	5.7

(6721) Lawrence's original records upon Stone Dam No. 2, brought down to date $27.45
Hazen thinks $29.00
(6721-3) The actual cost of the Davis Tunnel was $26.84 which sum, brought down to date, amounts to $34.00
Hazen assumes a figure of $30.00

Fourth Period	Approximate date of Construction	Length in feet	Diameter of circle of equal area
Sunol Tunnel No. 2	1908	856	6.2

The cost of this tunnel as built by the Western Pacific Railway actually "appears to be" $27.88
The cost of this tunnel was as follows:
Cost of drifting done by contract $9.00
In addition the contractor was furnished lumber costing $1,622 or, per ft 2.06
The labor in lining the tunnel cost $8,018, or, per ft. 9.20
Concrete and other materials used in construction furnished by the Company $6687, or, per ft 7.62
Total cost per foot. $27.88
(6726) Hazen gives his reason for allowing $31.00
(6935-7) Subsequent investigation, conference and correspondence with the Chief Engineer of the W. P. R. R., Mr. Wyckoff, developed the fact that the total cost of this tunnel, based on the tunnel length above, excluding the cut and cover section, was approximately $37.80
On the whole section, including the open cut $34.80
which led Hazen to conclude that the equivalent tunnel cost was, perhaps, about $36.00
although Hazen finally adopted for his estimate $31.00
Dockweiler $26.78 and Dillman $13.08. This subject will be discussed in detail later.
(6924) Note that Hazen comments upon his doubt as to the completeness of Lawrence's record of materials,
(6931) and other costs included in his original cost data because of certain omissions which he has, himself,
(8218) noted, and of the fact alluded to by Lawrence, that materials were sometimes sent to the works
(8224) without being billed to his department, though Hazen expresses confidence in the accuracy of Lawrence's labor cost records. Point was given to the soundness of this observation by the omission of cement in one case (6927) and of powder in another (6928), and of Lawrence's underestimate of the actual cost of Sunol Tunnel No. 2 drifting, which he had at $9.00 instead of $15.00 (6939). The Merced Tunnel, (not comparable with above mentioned rock tunnels) estimated cost, per lineal foot $35.00

Table 25.

Los Angeles Aqueduct Tunnels

Hazen states that Lippincott told him that the total cost of finished lined tunnels at Los Angeles, excluding City Government costs, Mulholland's salary, etc., was, per lineal foot $36.55
or, including the latter, approximately $40.00
The interior sections of the masonry lining were equivalent to a circle of about 8.3 feet in diameter. The material for the most part was granite of a varying degree of hardness, but taken right through, very much softer in character than some of the Eastern rock.

Table 26.

Cost of Eastern Tunnels: (Hazen)

Reference No.	Name of Tunnel	Approximate date	Dia. of circle of equal area	Length in feet	Cost per Lin. Ft.
38	Cleveland Land	1902	5.5	2,580	$21.50
50	Boston Sewer	1903	7.5	2,985	43.50
55	Cincinnati Water	1903	7.0	22,664	45.60
5	Little River	1908	5.9	4,526	29.00
49	Boston Sewer	1908	6.1	6,350	42.50
67	Boston Water	1910	6.3	2,042	45.60
78	Fitchburg Sewer	1912	4.0	1,503	22.03
	Hartford, Conn	1913	5.9	2,333	28.04
	Average of 8		6.0		$34.72
57	Toronto Water	1907	8.3	5,207	$51.50
39	St. Louis Sewer	1902	8.7	6,000	20.00
51	Boston Sewer	1902	9.6	5,300	43.80
7	Weston Aqueduct	1903	10.0	5,175	31.60
58	Philadelphia Water	1903	10.6	14,015	94.00
8	Weston Aqueduct	1903	13.2	6,286	51.40
59	Mooda	1910	14.5	26,000	134.00
60	Roundout	1910	14.5	24,870	235.00
61	Wallkill	1910	14.5	24,225	145.00
	Average of 9		11.5		$89.60
80	Neponset Sewer	1896	3.0	383	$24.88
83	" "	1896	4.0	1,728	16.20
82	" "	1896	4.3	486	19.67
81	" "	1896	4.5	499	18.59
19 to 37	Philadelphia Sewers	1894	5.0		21.69
"	" "	1894	6.0		27.40
"	" "	1894	7.0		33.00
56	St. Louis Intake	1892	7.0	1,670	64.00
6	Huntley Project	1895	9.0	375	28.12
9	Wachusetts Aqueduct	1896	12.6	10,331	46.50
	Average of 10		6.3		$30.00
40	Chicago Land	1899	8.0	22,183	$24.41
41	Chicago Intake	1899	7.0		33.61
42	Chicago Intake	1899	6.0		34.58
43	Chicago Intake	1899	5.0		32.81
44	Chicago Kedzie	1899	6.5	1,544	21.09
52	Boston Sewer	1901	11.4	2,627	67.00
54	Milwaukee Flush	1906	12.0	7,182	40.30
68	Sioux City, Ia	1910	5.2		15.59
	Average of 8		7.6		$33.70

Table 27.

Allen Hazen's Summary of Data on Eastern Lined Tunnels

	8 small in rock 1900-13	9 large in rock 1902-10	10 large and small in rock 1892-6	8 large and small in clay, etc. 1899-1910
Average diameter, feet	6.0	11.5	6.3	7.6
Approximate average cost of labor *per hour	20c	20c	15c	20c
Actual average cost per foot	$34.72	$89.60	$30.00	$33.70
Cost of common labor at 31c per hour (Labor 60% of total)	$46.00	$116.00	$48.00	$43.50
Ratio of cost of tunnel of this size to cost of a 6 ft. tunnel (d. l. 5)	1.05	2.66	1.12	1.41
Corresponding cost of a 6 ft. tunnel with labor at 31c per hour	$44.00	$43.50	$43.00	$30.90

*Ordinary labor on outside work. Higher rates are paid in tunnel work but records thereof in the several cases are not available, and the ordinary rate is taken as an index of the relative tunnel ratio.

(6723-4) Little River Tunnel, Springfield, 1908, cost per lin. ft. $29.00
Equivalent fair cost for 1913 ..... 35.00
(although the cost pro-rated in advance of labor and materials amounts to about $38.60.)
Dockweiler gives the original cost of the Pilarcitos Tunnel No. 2 ..... *$29.47
upon which Hazen gave $21.50.
*$29.47 should be $21.47. See page 6739.

I shall not make any attempt to read through these, your Honor. I think it will be more for a reference when there is opportunity for closer examination. It amounts practically to a review of some of Lippincott's most pertinent tunnels, in his own opinion, and Hazen's segregation of the Spring Valley tunnels, based upon the periods of construction up to the 4th period, where it will be observed that the Sunol Tunnel No. 2 is considered. You will find it stated in the paper "that the cost of this tunnel, as built by the Western Pacific Railway, actually appears to be"; that is derived from the Lawrence exhibit, which gives us his understanding of the costs, and which are segregated by Lawrence as they here appear on this exhibit. Later on Hazen gave his reasons for allowing $31 on that identical tunnel. After that there was investigation and there were conferences and correspondence with the chief engineer of the Western Pacific, Mr. Whyche, in which it was developed that the total cost of this tunnel, based on the tunnel length alone, excluding the cut and cover section, was approximately $37.80 per foot, and that the whole section, including the open cut, was $34.80, which led Hazen to conclude that the total tunnel cost was about $36, although he finally adopted, for his estimate, $31; for this same tunnel Dockweiler had $26.78 and Dillman $13.08. We shall discuss this tunnel a little later, before we close the argument. It is worthy of consideration that before these prices turned up, Mr. Hazen had commented upon the fact that he felt sure that some of the Lawrence costs were missing, and that the subsequent discovery just referred to proved once again the accuracy of Hazen's statement. Point was given to the soundness of this observation by the omission of cement in one case (6927) and of powder in another (6928) and of Lawrence's under-estimate of the actual cost of Sunol No. 2 drifting, which he had at $9 instead of $15 (6939), which the Western Pacific actually paid. The Merced tunnel estimated cost per lineal foot was $35. The Los Angeles aqueduct tunnels are considered on that page. On sheet 26 are

given the eastern tunnel data which Mr. Hazen employed; on sheet 27 is the summary and the use to which Mr. Hazen put that data.

Hazen's Summary of Data on Eastern Lined Tunnels.

Dockweiler cites the driving price, excluding cost of tools, timber, track and cars, of $6.60 per lineal foot upon a very small piece of work at the Crinkshank mine, but even this proved to be an estimate only (6773). Also an estimate of $6.60 driving cost per foot in slate for the Los Burros tunnel, where, too, the company owned the rails and cars, and where Dockweiler thought 400 lineal feet of tunnel had been driven, though he had not seen it since it started. He cites a further price of $6.50 per foot for labor, excluding powder, drills, rails, cars and water upon 150 feet of mine tunnel, being driven for him through schistose slate near Fresno (6973).

All of these citations it will be noted are upon insignificant, short, unlined mine tunnels, virtually prospect holes, absolutely incomparable with waterworks tunnels in every way and therefore of no comparative value.

Dillman, too, gave substantially no comparable data and but a few fragmentary costs (6793). The only waterworks tunnels cited by him were unlined tunnels driven under his direction at Oakdale through rock which he could whittle with a knife, with little blasting, and substantially no timbering, and which stood for years without lining. There were 6 of these tunnels on the north side, the lengths varying from 500 to 1485 feet, 10 feet wide by 6½ feet high, of 2 cubic yard cross sections. He says (6793) the contract cost for driving was $16 per foot paid, in bonds, that they were sub-let for $10 in cash and were again sub-let at $6.50 per foot in cash, to "station men" who averaged from $10 to $13 per day each, who drove the tunnels at a rate of 10 feet per face shift. He cites also the Owl Creek tunnel in hard green stone, the driving of which with the section 13 by 6½ feet, cost $24 per lineal foot without lining. He cites one other example

(6795-6) in which the excavation contract was $3.49 per cubic yard, and the lining $15 per cubic yard, the unlined section containing 1.6 cubic yards to the foot, and the lined section 2.1, making the excavation cost $5.60 and $7.35 per lineal foot, respectively, and the lining cost approximately $7.50, the total cost of the lined section being approximately $14.85; and refers to one example cited in Volume LXXV of the American Society of Civil Engineers, concerning the construction of which he was uninformed, and which was clearly not comparable with the tunnels under valuation. None of these citations are significant.

Issue Over Sunol Tunnel No. 2 Built by the Western Pacific Railway.

During the presentation of evidence issue arose over the construction of the Sunol Tunnel No. 2, which was relocated and built by the Western Pacific Railway, in order that it might locate its tracks through the Niles Canyon. Lawrence had stated that the cost of drifting it had been reported to him as $9 per foot, and estimated its total cost at $23,437.87 (6936; 6939). Hazen, after carefully reviewing Lawrence's figures had increased them to $26,536, and had finally assumed the fair reproduction cost of the tunnel, as of the year 1913, to be $31 per foot, or $26,536 (6723 Pl. Exh. 139). Lippincott estimated its cost at $31.88 per lineal foot, a total of $27,289.

Later the matter became an issue, under the cross-examination of Hazen, and further investigation by him, and conference with the Chief Engineer Wyche, of the Western Pacific Railway, and examination of the correspondence and accounts relating to the cost of this tunnel, developed the fact that the actual cost to the Western Pacific Railway had been $29,634.54, which, as Hazen stated, amounted on the length of the tunnel section alone, to $37.80 per lineal foot, and on the whole length including the tunnel section and the cut and cover work, $34.80. According to Hazen's judgment, a fair allowance for the cost of the tunnel

might be fixed at $36 per lineal foot. The latter figure, is approximately 16% higher than Hazen's estimate, 13% higher than Lippincott's (6935; 6937); 34% than Dockweiler's and 46% than Dillman's.

We submit that this incident gave further evidence of a striking nature of the soundness of Lippincott's and Hazen's tunnel estimates, and of the unreliability of Dockweiler's and, particularly, Dillman's figures, based, as the latter were, essentially upon incomparable unlined tunnel costs.

It seems unnecessary to comment in detail upon the figures of the several witnesses upon the individual tunnels, beyond calling attention to the fact that Dockweiler and Dillman finally admitted that they had not given due weight to the wet character of the Merced tunnel and Lake Honda tunnels; and that Lippincott, and Hazen, called attention to the fact that Lippincott had failed to make adequate allowance for the wet work in the driving of the Honda tunnel.

Conclusions Upon Tunnel Estimates.

In concluding comment upon the reproduction cost estimates of tunnels, your Honor's attention is called to the following significant facts:

First: The company's witnesses were the only men experienced in water works tunnel construction; Lippincott is probably the most experienced engineer in tunnel construction upon the Pacific Coast; Dockweiler had had little experience other than that afforded by the company's construction records; and that while Dillman had had considerable experience with tunnels, it was limited wholly to unlined tunnels, built, for the most part, for railroad service.

Second: The defendants' witnesses had no knowledge or conception of the greater cost of drifting lined than unlined tunnels, growing out of the necessity for more careful work to reduce, as far as practicable, the overbreak in order to keep within reason-

able bounds the excess of masonry required to backfill the cavities outside of the neat section created by the overbreak.

Third: Neither of defendants' witnesses made any allowance for the greater cost of drifting masonry lined tunnels due to overbreak, nor for the additional amount of masonry lining, resulting therefrom.

Fourth: The estimates of defendants' witness Dockweiler, were based partly upon the original construction costs of a few of the Spring Valley tunnels, and for the rest upon incomparable mine tunnels. Dillman's figures were based upon his past experience with unlined mine tunnels, and unlined or timber-lined railroad tunnels, and principally upon the irrigation tunnels driven under his direction at Oakdale,—through a soft sandstone which could be whittled with a knife, bored with an auger, blasted close to the neat section, through ground which did not slip, had no water in it, and was better to dig, he says, than the Spring Valley, but which did not stand up so well as the latter. On this point it is to be observed that his tunnels did stand without lining for a period of from two to three years, whereas the Spring Valley tunnels had to be lined; the Oakdale work required no ventilation, and could be driven by hand with the minimum labor and material cost, at a rate of 3 to 10 feet per-face-shift-per-day, although the other witnesses estimated the progress upon the Spring Valley tunnels at from 3 to 6 feet per day; finally Dillman's Oakdale tunnels were, in fact, driven by the men whom he considers the most experienced in tunnel driving west of Chicago, under contract sub-let to these experts called "station men," who he said made from $15 to $13 per day, which sum Dillman, however, cuts to from $5 to $6 per day in his estimates, while still adhering to the tunnel cost figures.

Fifth: In spite of the fact that Dillman does not know of any tunnels of any size driven and lined for $15 per foot, nevertheless, he estimates the reproduction cost of a number of the Spring Valley tunnels at substantially less than this amount.

Sixth: The defendant witnesses over-estimate substantially the number of brick per day which can be laid by the masons, and hence under-estimate the cost of brick lining; whereas the estimates of the plaintiff's witnesses were fully sustained by the evidence of the defendants' only witness who was experienced in brick-work, a practical and brick masonry contractor, J. J. Phillips.

MR. SEARLS: I take exception to that statement as a statement of what the record shows.

MR. GREENE: Seventh: Dillman based his estimate of the cost of lining the tunnels upon his first impression in regard to the cost of lining the Oakdale tunnels (years after their original construction under his direction) which he thought was $10 per cubic yard, and which finally proved to be probably between $17 and $20 per cubic yard.

Eighth: Finally Dillman and Dockweiler both deliberately concealed and disregarded the Western Pacific Railway's experience in the driving of Sunol Tunnel No. 2, although that information was obtained by them long before they testified and it subsequently showed, as appeared in the trial, a cost between $34.80 and $37.80 (based upon the whole section or the tunnel section alone, respectively) approximately 34% in excess of Dockweiler's estimate per lineal foot, and 46% of Dillman's.

MR. SEARLS: Is it your statement that they had that information prior to the time they made their appraisal and testified here?

MR. GREENE: Yes. That is in the record. I will give you the page.

MR. McCUTCHEN: You don't mean prior to the time they made their estimate, you mean prior to the time they testified here, Mr. Greene.

MR. GREENE: Yes, prior to the time they testified here.

MR. SEARLS: Will you give me the page of the record?

MR. GREENE: 7085. We submit that the judgment of plaintiff's witnesses upon the fair reproduction cost of the tunnels,

amounting to between $1,100,757 (Lippincott), and $1,124,095 (Hazen), is well sustained by the evidence adduced and fully justifies a finding for these tunnels of $1,100,000.

4. Buildings Outside of City.

The fourth group to be taken up in the discussion is buildings outside the city. The fair allowance for gross reproduction cost of buildings outside of the city (excluding the booster station building at Crystal Springs, structures 16 and 18, on page 75 of inventory, and structures 9 and 10 on pages 80 and 81 of the inventory, and excluding further, Pleasanton ranch houses, and overhead and interest-during-construction) was fixed by joint agreement of the city's and company's representatives at the sum of $150,000, in accordance with Joint Exhibit No. 140 (6729-30) with the detailed comparisons assembled in the Major Group Schedule volume.

In Joint Exhibit No. 140 will be found not only a comparison of the estimates of the individual engineers upon the several structures, together with the "accepted fair amount agreed upon, $150,000," but also (on page 6) a recapitulation showing a segregation of the $150,000 allowance for the buildings outside of the city, as between the buildings proper, $69,720; buildings upon reservoir and aqueduct lines, $800; pumping stations, $78,350; Sunol filter bed galleries, $130; and buildings on pipe lines, $1,000. In this connection attention is again called to the exclusions cited above, and to the fact that the buildings within the city were not covered by this agreement.

THE MASTER: Do I understand from that, that the Sunol filter galleries were the subject of that agreement?

MR. GREENE: Not at all, your Honor. These are what are called buildings, your Honor, but they are not properly called that at the Sunol filter galleries. And the amount here is only $130; it is on some little shack out there, as I recall it.

The tables referred to above were segregated in the manner

shown, in order that there might be no duplication of these structural values in any of the other schedules of the property, and elimination has, in fact, been made in the Major-Group Schedule of all duplications of structures.

The Pleasanton ranch houses were excluded from this list of "Buildings Outside of the City"; they were adverted to, however, in Item 22 of the Major-Group-Schedule covering "Structure Values not Discussed in Evidence," to which there appeared the following note in the column of remarks: "Of these amounts the Pleasanton ranch houses cover respectively: Farquharson, $170,-141; Dockweiler, $129,121, and Dillman, $198,792. Note that Dockweiler erroneously omitted to value the Hop-Ranch buildings." The detailed amounts entering into the valuations of the Pleasanton ranch houses, just referred to, are given in Plaintiff's Ex. 168 (8601-3) in gross amount, and in Plaintiff's Ex. 168a, in gross and net, or depreciated, amount.

The city claimed that the Pleasanton ranch houses should be valued as a real estate proposition (4822; 9489-90), and defendants' witness Callaghan gave in his Defendants' Ex. 184, his estimate of the present, depreciated, value of these buildings (and not of their gross reproduction cost) amounting to $85,030, comparable with the depreciated value shown in Plaintiff's Exhibit 168a, amounting to the following figures: Farquharson, $132,568; Dockweiler (excluding the Hop-Ranch buildings, which were valued by Dillman at the gross sum of $11,568), $69,886; and Dillman, $85,618.

The buildings in the city consist largely of the pumping stations which are included in the pumping station plant schedule.

THE MASTER: Mr. Greene, I am reverting again to this Major-Group-Schedule. Is that an exhibit in the case?

MR. GREENE: Yes, that was put in in the form of an exhibit, I think, your Honor, after we completed all the evidence.

THE MASTER: Has it an exhibit number?

MR. GREENE: I think we did not give it an exhibit number

in order not to have it sent up to the upper court; am I right about that, Mr. Searls?

MR. SHARON: It is this large volume here, your Honor (indicating).

MR. GREENE: I think we had better give the title of it. It has not any exhibit number, your Honor, but it is entitled "Summarized comparison in major groups, gross reproduction cost excluding overhead and interest-during-construction as of December 31, 1913, Spring Valley Water Company, April 10, 1916."

THE MASTER: Was this large volume that you speak of in bound form at the end of the case with the numerous comparative exhibits which you handed me during the trial and which were not introduced in evidence?

MR. GREENE: That is correct, your Honor.

THE MASTER: You don't want this in evidence?

MR. GREENE: We discussed it at the time, that your Honor would probably want to use it, and that Judge Van Fleet would also want to use it, but that it was useless to encumber the record with it. I would be very glad to have it introduced if your Honor thinks or if Mr. Searls thinks it is advisable to put it in. I see that your Honor smiles when I refer to encumbering the record.

MR. SEARLS: It seems to me there are a lot of tables here that were subsequently corrected, Mr. Greene.

MR. GREENE: I think those tables have been corrected, Mr. Searls. Mr. Sharon verifies me in that statement.

THE MASTER: I see on looking through it that in the collection of schedules which this volume represents there are included some that are in evidence.

MR. GREENE: There were some that were introduced in evidence as we went along, but I don't think that the great majority of them were.

THE MASTER: Of course, everything that is in it is in evidence in some form or other.

MR. SEARLS: I have no objection to its going in.

MR. GREENE: It strikes me now that it might be well to put it in; of course we could agree to omit it in case it ever becomes necessary to construct this record over again.

THE MASTER: Yes, that is something you can think of. Of course, it is perfectly obvious that in the event you ever have the necessity of making a record on this case you will probably omit a great deal of the matter that is actually in evidence, otherwise you would perhaps both be bankrupt. As far as I am concerned I don't care whether you give this an exhibit number or not; I had forgotten until Mr. Sharon brought it to my attention that I had such a volume here. There is no inconvenience at all in your referring to it as the Major-Group-Schedule without it having an exhibit number as long as I understand what it is. You had better leave the matter as it is and if you should decide that you think it is wise to give it an exhibit number, you can do so. Of course, there is nothing gained by it because it is all in evidence anyway.

MR. GREENE: Very well, your Honor.

5. Pumping Stations.

The fifth subdivision is pumping stations. The fair allowance for the gross reproduction cost of the pumping stations (excluding overhead and interest-during-construction) was fixed by agreement at the sum of $633,000 for the pumping stations outside of the city, and $542,000 for those within the city, or at a total sum for the pumping plants of $1,175,000, as appears in Joint Exhibit No. 152. In view, however, of the fact that the sum of $82,430 upon pumping stations outside of the city was covered in the joint exhibit of buildings, just referred to, Joint Exhibit 140 (the pumping station buildings within the city being shown only upon this pumping station schedule), this sum must be deducted from the total amount of $1,175,000 shown in Joint Exhibit 152, in order to prevent duplication of valuations, and to give the amount shown in Item 5, "Pumping Stations," in the

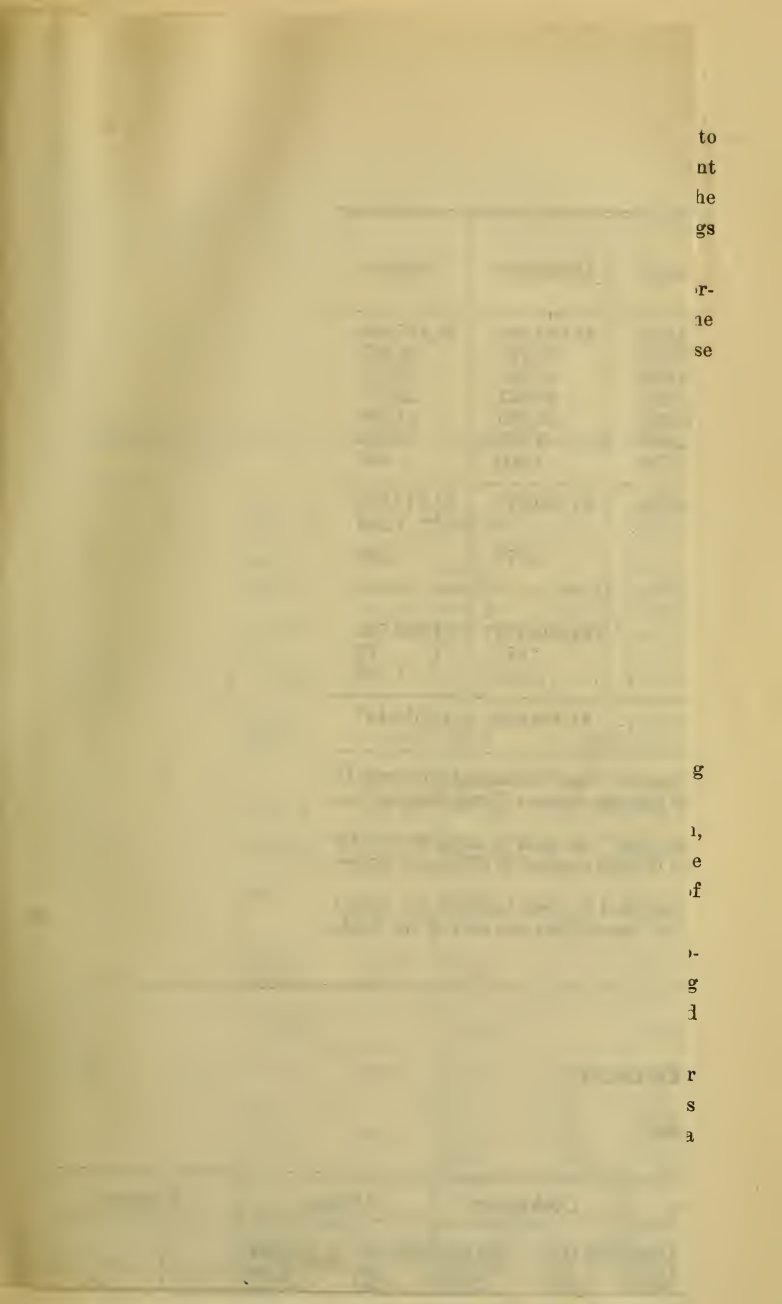

Table 28

Inventory Pg.	Inventory Str.	Name of Structure	Hazen	Lippincott	Dockweiler	Dillman
25	1	Lower Crystal Spgs. Dam	$1,547,588	$1,414,537	$1,044,849	$1,177,668
25	2	Howard Cut	107,102	103,056	70,791	68,657
25	3	Gate Tower and Stand Pipe	32,286	49,038	21,210	22,353
25	4	Intake Pipe	33,785	41,463	28,927	22,757
26	5	Outlet Tunnel	23,284	36,285	20,869	21,080
26	6	Bridge	2,115	2,657	2,169	2,186
26	7	Platform in Gate Towers	662	1,750	1,500	607
		Sub-total	$1,746,822	$1,648,786	$1,190,315	$1,315,308
			** 1,900	.....	.....	** 1,243
26	8	Boats	5,454	.....	5,178	4,209
26	9	Miscellaneous Structures				
31	33					
		Total comparable with Summarized Major Group Schedule	$1,754,176	.....	$1,195,493	$1,320,760
		Deduct from Dockweiler's and Dillman's Schedules	.....	.....	* '677	† 70
		Deduct from Hazen's and Dillman's Schedules	** 1,900	.....	.....	* 1,243
		Revised Totals	$1,752,276	.....	$1,194,816	$1,319,447

*Dockweiler's total in the Major Group Schedule covering "Crystal Springs Concrete Dam" includes Structures 12 (p. 28) and items 19-24 (p. 32) amounting to $677, which properly belong to Crystal Springs Booster Pump Station, but were erroneously omitted from the comparison upon "Pumping Stations."

†Dillman's total in Major Group Schedule covering "Crystal Springs Concrete Dam," in error in total $6 and by exclusion from the "Buildings" Schedule of (Dillman's $400—Dockweiler's allowance of $336 applied to Dillman's figures upon Structure 17, page 28 of Inventory), $64, making a total of $70.

**These amounts $1,900 (Hazen) and $1,243 (Dillman) covering "Boats" are included in their totals in the Major Group Schedule upon "Crystal Springs Concrete Dam," but are excluded here for the reason that the cost of the boats when purchased was included in "Operating Expenses."

Table 29.

COMPARISON REPRODUCTION COST ESTIMATES UPON

Itemized Structures—Crystal Springs Dam

Excluding Overhead & Interest-during-Construction

As of Dec. 31, 1913.

Pg.	Str.	Name of Structure	Quantity	Hazen		Lippincott		Dockweiler		Dillman		Newman	
25	1	**Lower Crystal Springs Dam**											
		Clearing	1,300 Ac.	$60.00	$78,000	$25.00	$32,500	$40.00	$52,000	$50.00	$65,000		
		Excavation Top Soil	11,870 cu. yds.	.40	4,748	1.50	17,805	.22	2,611	.25	2,968		
		Excavation Solid Rock	25,020 "	2.00	50,040	2.00	50,040	1.88	47,038	1.00	25,020	(x)	(x)
		Concrete in Place	157,200 "	9.00	$1,414,800	8.36	$1,314,192	6.00	$943,200	6.90	$1,084,680	$6.18	$971,496
		Total	.....	.....	$1,547,588	.....	$1,414,537	.....	$1,044,849	.....	$1,177,668		
25	2	**Howard Cut**											
		Excavation Top Soil	7,730 cu. yds.	$0.40	$3,092	$ 0.35	$2,705	$ 0.26	$2,010				
		Excavation Loose Rock	5,277 "	2.50	13,193	4.00	21,108	2.50	13,192				
		Embankment Clay	20,300 "	1.50	30,450	1.20	24,360	.80	16,240	1.00	20,300		
		*Riprap Ungrouted	34,040 sq. ft.	.10	6,808	.10	5,106	.09	3,064	.....	6,994		
		*Riprap Grouted	3,780 "	.20	378	.15	378	.22	832			(x)	
		Concrete Core	5,909 "	9.00	53,181	8.36	49,399	6.00	35,454	7.00	41,363	6.18	36,518
		Total	.....	.....	$107,102	.....	$103,056	.....	$70,791	.....	$68,657		
25	3	**Gate Tower & Stand Pipe**											
		Excavation Solid Rock	1,010 cu. yds.	$ 5.00	$5,050	$13.50	$13,625	$ 3.00	$3,030	$ 4.00	$4,040		
		Brick Lining	544.2 M	36.00	19,591	50.00	27,210	21.75	11,836	25.00	13,605		
		50" C. I. Pipe Flanged and recessed in place	81,540 lbs.	.065	5,300	.07	5,708	.049	3,995	.04	.....		
		Remaining Items	.....	.....	2,345	.....	2,495	.....	2,349	.....	4,708		
		Total	.....	.....	$32,286	.....	$49,038	.....	$21,210	.....	$22,353		
25	4	**Intake Pipes**											
		Brick Lining	207.2 M	$50.00	$10,360	$50.00	$10,360	$37.75	$7,822	$25.00	$5,180		
		44" C. I. Pipe Flanged & recessed	200,577 lb.	.065	13,038	.07	14,040	.05	10,029	.04	.....		
		3-Double Faced waste water gates 44" C. I. with operating mechanism	3 each	$1200	3,600	.....	2,000	$1400	4,200	$1500	4,500		
		Valves Gates C. I. Pipe, etc	.....	.....	6,787	.....	15,063	.....	6,876	.....	13,077		
		Total	.....	.....	$33,785	.....	$41,463	.....	$28,927	.....	$22,757		
26	5	**Outlet Tunnel**											
		Excavation Solid Rock	1,379 cu. yds.	$ 4.00	$5,516	$ 7.28	$10,039	$ 3.65	$5,033	$ 4.00	$5,516		
		Brick Piers	322.6 M	30.00	9,678	50.00	16,130	23.25	7,500	25.00	.....		
		Riveted steel pipe 54"	358 lin. ft.	14.00	5,012	.....	5,538	14.75	5,280	13.25	4,744		
		Miscellaneous	.....	.....	3,078	.....	4,578	.....	3,056	.....	10,820		
		Total	.....	.....	$23,284	.....	$36,285	.....	$20,869	.....	$21,080		

(x) Newman's figure $6.49 incl. $0.31 per yd. for Supt. & Engineering.

* Hazen & Lippincott's totals for this structure should be decreased by Hazen $3,026—Lippincott $1,513 due to transposition of Riprap quantities: Riprap grouted should be (3780)—ungrouted 34,040 sq. ft. Dillman's amount of $6,994 includes excavation, loose rock and Ripraping.

"Major-Group-Schedule of Gross-Reproduction-Cost," amounting to $1,092,570. This latter sum ($1,092,570) is therefore the amount to be placed upon the pumping plants within and without the city, though it excludes certain of the pumping station buildings which are covered elsewhere.

The details of the joint agreement are shown in the Major-Group-Schedule volume, and comparison of the estimates of the three engineers,—Hazen, Dockweiler and Dillman,—upon these structures is shown in the summarized comparison thereof.

6. Crystal Springs Concrete Dam.

The witnesses upon this segregation were:

For plaintiff:	For defendants:
1. Allen Hazen	1. George L. Dillman
2. J. B. Lippincott	2. J. H. Dockweiler
3. George R. Gay	3. Jerome Newman
4. S. P. Eastman	4. W. A. Bechtel
5. J. J. Sharon	5. R. T. English

I will now take up Tables 28 and 29.

[Tables inserted opposite]

We have, first, the Major-Group-Schedule Summary, excluding overhead and interest-during-construction:

Allen Hazen, $1,754,176; Dockweiler, $1,195,493; Dillman, $1,320,760; excluding the buildings in Joint Exhibit 140 and the Booster Pumping Station. "For Lippincott's figures upon part of these structures see detailed analysis hereto attached."

The latter reference is to Series VIII in the Major-Group-Summary volume, which gives all of the detailed figures making up the above sums. Newman's partial estimate is to be found under Defendants' Exhibit 116.

In the tabulations which we have just handed to your Honor are given, first, a concise statement of the more important groups of items entering into the above stated amounts; and second, a

segregation of the costs as between different classes of work—clearing, excavation, concrete in place, etc.

Summary of Original Cost Data:

I will take up first the summary of original cost data. Counsel for the defendants introduced in Defendants' Exh. 186 (9539) the audit of the company's books by A. Wenzelburger, expert accountant for the city in the 1903-5 rate cases, upon the original cost of the Crystal Springs concrete dam and of the so-called "Howard Cut," under active construction during the years 1887-8 and 1890, although the entire construction covered the period from 1886 to 1895, and amounting to $2,242,688.92. This sum, however, includes the cost of certain parcels of land and of raising the upper Crystal Springs dam, as well as partial allowance for engineering and local supervision, but not general overhead and administrative expenses. Making allowance for the former we have a table showing those figures, which I now hand to your Honor, and which shows a total, excluding the cost of raising the dam, $1,946,-170. The note at the bottom of the table refers to the expenditure of $10,000 incurred in raising the dam in 1911, including engineering and local supervision only and excluding general overhead and administrative expense.

Table 30

(a)	Wenzelburger's Audit of Original Cost.....		$2,242,688.92
(b)	Deduct from Lands and Water Rights, as per statement of Metcalf, based upon Sharon's analysis (7747; 5434).....	$262,478	
(c)	Raising Upper Crystal Springs Dam, as per statement of Hazen, based upon analysis of Sharon (5434; 7747).....	34,041	
			296,519.00
	Total excluding the cost (about $10,000) of raising dam in 1911, including engineering and local supervision only, excluding general overhead and administration expenses.....		$1,946,170.00

THE MASTER: Now, I am not sure that you are giving the right impression there if this table is correct. This table shows that the total of the Crystal Springs dam costs, including engineering and local supervision but excluding general overhead and administrative expenses was $1,946,170: and excluding from that amount however a minor sum of about $10,000 for raising the dam in 1911.

MR GREENE: That is the impression I intended to give your Honor.

THE MASTER: You spoke of the inclusion of the field overhead and the exclusion of the general overhead in connection with the $10,000.

MR. GREENE: That was an error, I didn't mean to do that.

THE MASTER: Yes, that was an error. We don't care particularly whether the $10,000 included overhead, or not, because the amount is so small. This was the figure that Mr. Hazen adopted for cost, was it?

MR. GREENE: That is it. The figure which he gave was $1,945,000 as cost.

It will be shown later that Hazen's reproduction cost estimate, on a comparable basis, was but 3½% in excess of the original cost; Lippincott's approximately 3%; whereas, the estimates of the defendants' engineers were Dockweiler, 62%; Dillman 68% and Newman 2/3, approximately, of this original cost.

Experience of Witnesses:

Hazen's general qualifications in the waterworks field have already been discussed, and reference has been made to his technical training in this country and in Germany; he has written upon engineering subjects, amongst them matters relating to dam construction. In connection with many of his examinations and reports upon existing works, or plans for additional works, Hazen has had intimate contact with dam construction on a large scale, as for instance, at Austin, Texas; Baltimore; Minneapolis; Pitts-

burgh, and many other cities in this country; Winnipeg and Ottawa in Canada; and Brisbane, Australia.

In connection with his work upon the additional water supply of New York, he has had occasion to examine the details of design and construction of the large dams recently built, more particularly with the big Kensico dam just completed. He felt that his recently built masonry dam at Springfield, Mass., upon his own designs, was particularly helpful by way of comparison with the cost conditions here prevailing. He was one of the engineers especially appointed by President Roosevelt to report upon the Gatun dam and upon the general conditions of the work upon the Isthmus of Panama.

In his appraisal of the property of the Denver Union Water Company, as chairman of the board, he had intimate acquaintance with the Cheeseman Lake dam, one of the largest and finest structures of its kind in the world. Incidentally, he had examined many——

THE MASTER: Is that a concrete dam?

MR. GREENE: Yes, your Honor.

Incidentally he had examined many of the masonry dams upon the Pacific Coast, at San Diego, the Sweetwater, lower Otay, and other dams in the southern part of the state; the Le Grange and Spaulding dams; and the new dam at Seattle, Victoria and Vancouver.

In opening the discussion upon dams he gives an interesting historic resume of progress in dam building (5410), in the course of which he states:

"Then developments made a radical change in the whole business of building masonry dams, and nearly all of the large masonry dams that I have known about—and I have known about a large proportion of those built in this country in the last ten or fifteen years—have been built by this method of cyclopean masonry."

He showed his familiarity with a number of the large dams recently built, not only as to figures of cost, but detailed methods

of construction actually used, having visited the dams again and again during their construction, making use, for purposes of comparison of the Kensico, Ashokan, Wachusett, Cross River, Hartford, Columbus, Lock Raven, Pittsfield, Alexandria, Va., Springfield, Holyoke and Spaulding dams, as to all of which, with the single exception of the Alexandria, Va., dam, he had detailed information (Plaintiff's Ex. 111; 5421-5427 et al.).

He showed himself thoroughly familiar with the Spring Valley structures, having gotten all of the information which he could from Mr. Schussler, Lawrence, Sharon and other employees of the company, as well as from the available records of cost reports and photographs of the construction.

J. B. Lippincott, as hydrographer for the U. S. Geological Survey from 1894 to 1904, had come into intimate contact with dam construction, reporting upon a number of possible Federal propositions, including the building of a dam in Arizona on the Gila River at San Carlos, and had made investigations and reports on the construction of dams on Stony Creek, the Kings River, and the Santa Inez River near Santa Barbara, and on the Laguna dam in the Colorado River. He had charge of the construction of about 40% of the latter, and of the building of the Santa Barbara dam which will ultimately be raised to a height of 180 feet. He had reported upon the Idaho dam for the City of Mackey, and had given serious consideration to different types of dams in his studies, as a member of the Los Angeles County Flood Control Board. He had familiarity with many other waterworks properties which included dams amongst their structures, and had very extensive experience in the making of concrete, notably upon the construction of the Los Angeles aqueduct between the years 1906 to 1913, as Assistant Engineer to Chief Engineer Mulholland. It is clear, therefore, that Lippincott, too, knew this subject thoroughly.

The other witnesses for the plaintiff, Eastman, Gay and Sharon, testified only as to certain structural elements or materials, there-

fore it is not necessary to dwell at length upon their qualifications, reference being made to them incidentally.

Dillman had had extensive experience in the use of concrete, more particularly in railroad structures, but not in water-proof waterworks structures. He states that "My acquaintance in large masonry dams is not extensive" (5935), and his disregard of records of construction is to be borne in mind here also. He states that the largest dam of which he had had charge was the building of the power flume at Oregon City (5687), an insignificant structure 60 feet in width and 100 and some odd feet in length, and which carried 20 feet in depth of water (4264). It is clear that Dillman's experience in masonry dam construction was negligible—in no wise comparable with that of Hazen and Lippincott.

Dockweiler, it will be remembered, had never constructed any part of an existing waterworks system, nor of what was at one time a waterworks system, had never had constructed under his supervision or direction any substantial element of a waterworks plant, and never had anything to do directly with the operation of a waterworks system (4225). Moreover, he had done substantially no construction work since the year 1899 of any kind, and had done but little before then (4202).

He showed no familiarity with the details of construction or of construction costs relating to large masonry dams other than original cost records of the Crystal Springs dam. His estimate of the Crystal Springs dam, as all of his other estimates, were made up synthetically on the basis of partial cost records which he had collected from various sources, coupled with an estimate made for him by R. T. English, upon the cost of quarrying the rock, and of mixing and placing the concrete, stating in this connection that he had asked him to do this instead of doing it himself.

(5737) "MR. DOCKWEILER: Because he [Mr. English] is a specialist in that matter, and as I never poured any concrete on a dam of this size" [nor, we might add, upon any masonry dam

of any size], "and as there had been a great many improvements in vogue in the past ten or twelve years, and, as I state, he had experience in the pouring of concrete on bridges, where it is very essential that the materials are properly mixed, and where the work is most difficult, and being conscious of the fact that he was equipped by experience to do that work, I selected him to make these studies."

In this connection, note Dockweiler's own lack of appreciation of the difference in the character of work necessary in the building, and more particularly the bonding of a water tight masonry dam as compared with bridge construction, and English's own admission that he had no personal familiarity with dam construction or knowledge concerning it, and that he had never been on dam construction of this nature (5671 et seq.). Dockweiler states that he went over, verified and checked English's figures, and, as a matter of fact, it appears that many of the latter were given to English by Dockweiler himself.

In view of these facts, and of the inadequate character of English's figures as well as the fact that Dockweiler's concrete estimates were substantially lower than Dillman's and Newman's which were themselves too low, we shall spend but little time upon Dockweiler's testimony upon the Crystal Springs dam.

Jerome Newman (5798 et seq), 53 years of age, resident of San Francisco; civil engineer since 1887; was graduated from the University of California in 1883 and took a three years' post graduate course at the Polytechnic School in Berlin, 1886; worked for the Northern Pacific, Southern Pacific, Atchison, Topeka & Santa Fe, and the San Pedro, Los Angeles and Salt Lake railroads up to three years ago. Under Mr. Hood he made estimates for all new work, including concrete structures; had field work with the Northern Pacific and the Atchison, Topeka & Santa Fe, going into the field and watching the execution of his plans, and keeping cost records. But up to this time, "three years ago", it is to be noted that he had had no experience, so far as the record

indicates, with waterproof hydraulic structures. During the last three years, however, he had been chief engineer of the Board of State Harbor Commissioners. He had had personal charge of the construction of six reinforced concrete piers, containing, approximately, 250,000 cubic yards of reinforced concrete, a 15-foot concrete lined tunnel under Fort Mason, a reinforced concrete roundhouse, and various smaller structures. He was, therefore, experienced in the making and handling of concrete, but not in the particular work of dam construction, with which he had had nothing to do.

R. T. English, witness for the defendants, upon whose estimates of the equipment and cost involved in the making, mixing and placing of the concrete, Dockweiler based his figures, was 33 years of age, and resident of Baird, California; had had fifteen years of construction experience, chiefly on concrete work. His first work was upon the construction of the concrete piers for the C. M. & St. P. railroad bridge across the Missouri River at Mobridge, S. D., where he was superintendent of the mixing and placing of the concrete, installed the plant, built the forms, etc. Later he did similar work on the Cannon River bridge, four miles north of Red Wing, Minnesota; upon three bridges across the Mussel Shell River in Montana; the five-span concrete arch bridge across the Sacramento River near Redding. He also built some small structures for the Great Western canal, six miles from Oroville, and finally had been superintendent of construction for the past 18 months for the Ross Construction Co., which was doing highway work at Sacramento for the California State Highway Commission (5614-17).

It is significant to note the progressive increase in costs of mixing and pouring concrete (excluding form costs) cited by English, 40c, 65c and $1.10 per cubic yard (5615-16), which we apprehend was due rather to his own increased experience and greater care in cost ascertainment than to any actual difference. We doubt the completeness of the witness' figures, as he himself

admits that he is unable to give the cost of the finished work which involved the figures cited by him, because a superintendent in charge of railroad construction is not in a position to know the cost of the finished work (5678-9). He was unable to tell what the final cost had been on any piece of work with which he had been identified, although he had seen some of them, and he says "I was generally starting another bridge and all I looked for was to see whether we made or lost money" (5680).

The inadequacy of the witness' allowance on rock quarrying (5620-1), and particularly on the cost of forms (5628-34), his use of 1″ by 6″ No. 3 common boards with 2″ by 4″ uprights, so light and flimsy in character that defendants' own witness Newman refused to approve them (6110); his inadequate allowance ($3,140) for power incident to the mixing and placing of the concrete, etc., on a work involving a total cost of aproximately $1,200,000, according to defendants' lowest estimate, and requiring, even on his estimate, 377 days of construction as against the estimate of $11,004 by defendants' witness Newman, and yet higher ones by plaintiff's engineers; his inadequate total allowance for cost of equipment, $22,803, as compared with Newman's allowance of $45,000 and admissions that he had never known of so small an equipment cost as that upon a work of such magnitude; his inadequate allowance for water, 500 gallons or 10 barrels per day, being estimated by him as sufficient to season the concrete on the whole work (5656); his use of a central delivery chute, 140 feet above the point of placing, for the entire dam, though he had never known or seen one used on concrete construction; his inadequate total allowance for lumber for forms, 44,000 feet board measure for sheeting and studding and 40,000 more for bracing, with an assumed re-use of it ten times over, as against Newman's allowance of 480,000 feet board measure; his allowance of but two carpenters and but one helper, with one additional man to distribute the lumber upon a concrete dam involving 157,000 cubic yards of masonry; these and other details of his estimates all go

to show the total inadequacy of his experience to justify the forming of a sound judgment as to the necessary provisions for the execution of a work of this character or magnitude, and we shall not discuss his testimony further.

Basis of Estimate:

Hazen used three lines of evidence in making his estimate, first (5412), "the cost of the materials and the labor required to build the dam, as I should estimate them ordinarily"; second, "a consideration of the contract prices of recent large masonry dams, and as to those I have attempted to make an allowance for the differences which I have already mentioned and some other differences"; third, "I have taken into account the actual reported cost of construction of this dam."

In Plaintiff's Exhibit 111 (5410-12) Hazen gives a very interesting historic sketch of the important changes that have come, in the methods of building large masonry dams, since the Crystal Springs dam was erected, concluding with the introduction of Portland cement concrete, which led to the construction of cyclopean masonry.

All of the large masonry dams of which he has known, he says, —and he knows about a large portion of those built in this country in the last ten or fifteen years.—have been built by this method, of cyclopean masonry, which is one of the important means for reducing the cost of such structures. As he later points out, however, to build dams by this method, it is necessary that quarries be at hand to furnish hard stone for construction. Though usually present upon dam sites, they were lacking here. Similarly, suitable sand was not to be had. And finally, the dam site was 4.2 miles distant from the nearest point on the railroad (5411).

(5412) "So that there are those three conditions relating to the Crystal Springs dam, the absence of quarries from which good building stone could be had for making cyclopean masonry; the absence of sand on the site, and the absence of railroads and the chance to build a railroad to the site. Those three conditions are

very important. In using the cost of other dams they have to be kept in mind."

Hazen spoke appreciatively of the character and quality of the Crystal Springs dam masonry work, because he had a just appreciation of the difficulty in building so tight a concrete dam.

(5436) "I want to say before leaving Crystal Springs dam that it is a magnificent piece of masonry construction. After standing exposed to the weather for twenty-five years, and having gone through the earthquake, it is in as good condition as could be expected of a dam that was finished last week. There is not a defect in it. It is tight; it is a very creditable performance."

Upon the question of contract or day labor construction, Hazen, it will be remembered, significantly said:

(8246) "The question of contract came up. This might be a duplication of my testimony, but if there is any doubt about it, I would like to have it clear. It is my thought that on some kinds of work that enter into the construction of this system that the Spring Valley Water Company with its own men could do the work more advantageously than it could be done under contract and that they naturally would do all such parts of the work in that way; that would include the laying of pipes in the city; I certainly think they would not want a contract there. There are other parts of the system where I think a contractor could do the work cheaper than the company could do it; the contractor could (8247) do the work and make a profit and do it to better advantage to the company than the company could do it by day labor. Just what parts those would be I have not altogether separated. It would depend on local conditions as the work developed. But wherever I thought the work could be done advantageously by contract I assume that it would be done, and I assume that the contractor would make a profit that would be normal for those parts of the work. In a general way I think that would cover the dams and the outside pipe lines and perhaps the tunnels. There might be a debate on some of those items. Generally speaking I think the

Spring Valley Water Company—and by that I do not mean necessarily the identical organization that they had, but generalizing it, the company building this system, with good average engineers, such as they would be likely to have, they would have in their organization men normally with experience, and equipment and capacity for building a structure like the Crystal Springs dam comparable to what a good many contractors have. It is my notion that they could let a contract for that and that a contractor could do those parts of the work and make a profit and do it more advantageously to the company than it could be done by day labor and take all the risks, the risks of bad methods and the risks of accidents and all that would go with it, in other words, I am assuming that they would use the contract or the day labor system, just whichever was best adapted to each particular part of the work. It seems to me when we get contractors' costs, taking the record of what it cost a contractor, if we can get it, which we very rarely can because the contractor is not under any obligation to give us those figures, if he does he does it voluntarily, and we are not often times sure as to what it includes, but if we assume that the principal can do the work at the same cost as the contractor—I don't think it is a fair assumption (8248), it is not justified by facts, the contractor can normally do the work cheaper than the principal can do it; otherwise there would be no object in letting the contract. In connection with such figures a profit must be figured. In connection with work that is normally and advantageously done by day labor by the principal and it had best be done that way, in that work I have not assumed any contractor's profit."

In comparing his method of estimating the reproduction of the Crystal Springs dam with that adopted by Lippincott, Hazen says further, in answer to your Honor's question:

(5509) "THE MASTER: Mr. Hazen includes contractor's profit?

"MR. HAZEN: A. I have included contractor's profit. I

assume a moderate normal contractor's profit all the way through. But with the idea that any parts of the work that can be advantageously constructed in another way, and ordinarily are so constructed, will be so constructed. For instance, in the pipe laying in city streets, it is the exception to contract that, and I have not figured any contractor's profit in my estimate for that; but on dam construction and tunnel construction, and the large pipes, it is customary to do the work by contract. It is rather the exception to do it by day's labor; without making a hard and fast rule, I have generally followed the predominating method. I suppose among American cities, there is not one city in ten that could afford to do work of the kind represented by the Los Angeles aqueduct by day labor; the (5510) other nine-tenths of the cities will spend a great deal more doing it by day's labor than the work could be contracted for. Among private corporations, the percentage that can be done by day's labor is greater, I should think perhaps; however, I would not want to put a hard and fast rule for work of that kind."

Lippincott assumed that the concrete would be built with expansion joints but not with so many as in the original construction.

He also assumed proportions of 1:3:6, whereas the actual proportions used upon the dam were somewhat richer, approaching 1: 2: 5 (5467-8).

(5495) Lippincott based his estimate upon day labor costs and observes that it is hardly the figure he would expect the contractor to bid on the work, for it does not include profit (5494-6).

He made his estimate in accordance with his general practice, by adding to the unit cost of materials and labor an additional allowance, which he fixed at 40%, to cover the field overhead, auxiliary or indirect expenses, entirely independent of the general administrative, overhead and interest-during-construction charges (5497, 5502).

In discussing his 40% auxiliary cost item he refers significantly to the fact that—

(5496) "There are two periods of grief in the construction of a job—sometimes more, but there are two quite certain periods of grief; one is the period during which you are organizing and during which things are going wrong generally and in which you are trying out the men who are satisfactory and the men who are unsatisfactory and trying to reach an organization which is an efficient machine; the other period is when you are nearing the end of the piece of work and everybody realizes that the end is approaching, and the time for them to go down the road as they say, has about been reached, and they slow down and they lose their ambition to make a record in prices and quantities of work, they are drifting along and holding on to the jobs. These figures that I have I think will take care of that."

Hazen, commenting upon Lippincott's direct and indirect charge basis of estimating cost, says:

(5508) "MR. HAZEN: I think this illustrates the difficulty that I spoke of when I was speaking of the Los Angeles data some time ago. It is very difficult to compare statistics from different works, unless one thoroughly understands all the facts and goes into them adequately. When I meet Mr. Lippincott, not in this case, I do not mean, but some place else, and we talk of concrete, he tells me that he puts it in for $5 a yard, we will say, not attaching any significance to the figure, and I tell him $7, and he thinks that I am a very expensive man, and I do not see how he does it; but when we get together and thresh it all out, we are not talking about the same thing. I include in my figure the whole cost of doing the work right up to the supervision, and he includes only direct costs, and he has his indirect costs which he is carrying in another column, and which really makes up the difference. When we get together and thresh out the problem to the end, we find we are not so far apart; that is characteristic of cost data all over the country. Different organizations keep their

records in different ways, and in my experience it does not do to take it too seriously, unless one really knows just how it is done."

Dillman says:

(5688) "In reproducing the Crystal Springs dam, I have used a method different from anyone else here, but I think it is a practical method of getting material. I have considered all material, except the cement, as coming from Niles or the Livermore Valley. A contractor, as a general thing, can be considered an assembler rather than as a manufacturer of parts, and if he can buy his material cheaper than he can produce it, he would better do it;"

* * * * * * * *

(5689) "I reproduced the identical structure in the identical location and on the identical lines as built. The only change in my method is in the use of gravel instead of the rock that was used."

Occasion will arise later to consider that statement.

"I have allowed in my forms enough to make these [interlocking] blocks, but I should not reproduce those blocks if I were to rebuild the dam. I should pour that concrete, make it as nearly a monolith as possible. * * * I see no benefit in the block form. As a matter of fact, the block form has been an expense without adding value."

It may well be asked in the light of these, and some subsequent remarks by Dillman on the subject of porosity, how a structure can be identical if the materials and methods of its construction are changed, and it may well be questioned whether Dillman did not, in fact, here as in the case of the earth dams, reproduce a structure of his imagination, rather than the existing structure. More of this later, however.

In making up his basic figures of cost of concrete per cubic yard Dillman added arbitrarily $1 per cubic yard, plus 4c to bring his estimate to a round figure, and states that this total ($1.04) amounts to 18% of the basic cost of $5.86.

He states, after long and apparent evasion, that a contractor would add 15% for profit, but that if he knew he could make 5% he would be willing to do the work, and states that the extra 10% is to cover all contingencies, accidents, incidentals, etc. (5709, 5915-16, 5921). He admits that the casualty insurance and his estimate on his first assumption of weight-of-concrete might wipe out the profit item (5921-3), and though he is unable and unwilling to attempt to segregate or analyze his allowance, he is convinced that it is quite adequate to cover all the necessary items and provide a reasonable profit. In answer to your Honor's question, "What would you say would be a reasonable profit for a contractor on a job of this kind?" he says: "A reasonable profit to estimate at first is 10 to 15%, but there is a leeway in all these prices so that he might realize 25% on the figures I have given, and I don't doubt on letting this work you would get bids from responsible men to put this contract in away under my figures, possibly below $6.00". (He means per cubic yard of concrete.) (5916).

If Dillman honestly meant what he said, we submit that he has done the city grave injustice in figuring a cost of $6.90 per cubic yard, when he believes that responsible contractors would have taken the contract at nearly $1.00 per cubic yard less.

We submit, however, that it was but another evidence of Dillman's rough and ready way of guessing at construction costs without recognition of the real character of the structure, the cost of which he was estimating and in this case the superior quality of which he himself admits.

Upon the clearing of the site, Hazen estimated $60 per acre, Lippincott $25, Dockweiler $40, and Dillman $50. The difference between Hazen's and Dillman's figures is not of great importance ($78,000 and $65,000, respectively), but it is, perhaps, worthy of note that Hazen's figures were confirmed by the figures adduced by Herrmann and the other engineers in the discussion of the "Earthen Dams". Lippincott's figures are clearly too low.

Top-Soil Excavation:

The differences in the total allowance for excavation of top-soil are so comparatively insignificant as to make comment unnecessary. Lippincott's high figures come from past difficulties experienced by him in handling water, and he doubtless made a segregation between this and the preceding item different from that of the other engineers.

Solid Rock Excavation:

Upon the solid rock excavation, amounting to 25,020 cubic yards in the lower Crystal Springs dam, Hazen and Lippincott allowed $2 per cubic yard, Dockweiler, $1.88, and Dillman, $1, and upon the loose rock excavation of the Howard cut, amounting to 5277 cubic yards, Hazen and Dockweiler allowed $2.50 and Lippincott $4 per cubic yard.

In the light of these figures, and the discussion in connection with the earth dams, we submit that Hazen's figures are fair and should prevail.

Clay Embankment:

20,300 cubic yards of clay embankment were involved in the Howard cut. Upon this Hazen allowed $1.50; Lippincott $1.20, although he stated that he had not had much experience with puddle clay embankment (5486-5752); Dockweiler 80c, and Dillman $1. As this subject was thoroughly covered in the discussion of the earth dams, it is unnecessary to give it consideration here. It is sufficient to say, that judged by the standard of experience Hazen's figures should be accepted.

Concrete in Place:

There remains for consideration the most important item of this group, the fair cost of "Concrete in Place", in the lower Crystal Springs dam and the Howard cut, the evidence upon which will now be analyzed in detail, and "Brickwork", which has already been considered in connection with "Tunnels", and to which brief

reference will be made after the discussion upon "Concrete in Place."

The other items are not of sufficient importance, in amount involved, to justify extended discussion here. In determining the reasonable allowance for them the experience and candor of the witnesses will doubtless control.

Hauling:

Hazen estimates the cost of hauling (5413) "not on the present excellent road for a part of the distance, but rather on the conditions as they had been through the period under consideration".

He stated that with an uphill road, such as this, a rate of 25c per ton mile could be obtained, with an addition of 5c per ton mile for maintaining the roads, the latter sum being equivalent to an allowance of $25,000 for road work, or approximately $6,000 a mile during the period involved in the construction of this structure, approximately two years.

(5413) His total cost of hauling is thus 30c per ton mile.

Hazen finds that his allowance for hauling the materials to the site of the Crystal Springs dam on the basis of 30c per ton mile, and a distance of 4.2 miles, is equivalent to 90c per cubic yard of concrete (5419), which sum, however, is included in the specific items of materials entering into the structure, sand, cement and gravel.

Lippincott, who has had a very large experience on hauling costs in California, both by contract and by day labor, fixed his basic price for hauling at "25c a ton mile for hauling to the San Mateo dam, considering the rise in elevation, and the character of the road" (5469).

His experience indicated a range of cost from 15c to 50c per ton mile (5468-9).

Dillman allowed (5694) 20c a ton mile hauling, and says of that figure in his easy going assertive manner:

"This is an exceptionally fine hauling contract. There is something over a million ton-miles which, at 20c a ton-mile, will amount

to $200,000. It can be done for that price and a magnificent profit made by the contractor who properly handles his equipment, and the equipment entirely wiped out on the job."

He states further that there is ample margin in this price to pay $5,000 or $10,000 worth of repairs; that the county always maintains the road; but there is leeway enough in this figure to do all that sort of work.

Note, however, that he bases his hauling costs upon an assumed weight of 2700 pounds of sand and gravel, and 500 pounds of cement, or 3200 pounds per cubic yards of masonry, and a distance of 4 miles instead of 4.5 (5923), whereas Hazen pointedly calls his attention to the fact that the concrete weighs approximately 4050 pounds, as was subsequently shown by actual test. Thus does Dillman underestimate his hauling weights, as he does later his allowance for concrete, by 20% (5694-9). And he does this in the face of quotations received from the Grant Gravel Company of mixed gravel weights from 2900 to 3000 pounds per cubic yard; from the Rhodes Jamison manager, 2800 to 3000 pounds, though the Niles Gravel Company's quotation was between 2600 and 2700 pounds.

Newman allowed upon his sand and lumber and materials generally, 17c to 18c per ton-mile for hauling, and on his cement 17c per barrel, which was equivalent to 21.4c per ton-mile (5806, 6113).

Dockweiler also used 4-mile haul and allowed 30c a ton-mile (5734).

Newman was in error, however, in assuming the length of haul to be but 4 miles, for, as was shown by Hazen and Lawrence after re-measuring the ground, the distance to the bottom of the dam was found to be 4.2 miles, and to the top of the dam 4.5 miles, which would increase his hauling charge by about 7% to 8% (5807).

Newman made no allowance for the building or surfacing of the road, assuming that the county would be required to do this,

in spite of the fact that the road had not been surfaced by the county at the time of the actual construction of the dam, nor in 1913. He did make allowance, however, of $3000, which was to cover maintenance of his 4 miles of road for a period of two years (6126-7). Later, he increased this allowance to $3000 for construction and $6000 for maintenance (6143), which, according to the plaintiff's engineers, is still totally inadequate to maintain the road during a period of such active use.

W. A. Bechtel, witness for the defendant, general contractor of Oakland, California, testifies upon motor truck hauling based upon an experience extending from the year 1913 to date, and stated that motor trucks had first come into use in that part of the country in 1912. So that at most, these trucks would probably not have been used if at all, until the end of the rating period.

Based upon the counsel's categorical question as to a fair contract price for hauling sand and cement necessary for the construction of 157,000 cubic yards of concrete, involving about 250,000 tons of material, to be hauled over 4 miles of road from San Mateo to Crystal Springs, making a total of approximately 1,000,000 ton-miles with a "good macadam road"—I call your Honor's attention to that—to be kept in repair by the contractor, and assuming further that the contractor would have to furnish his own facilities for convenient loading of the sand and gravel automatically from bins, and the cement by hand from a cement house, Bechtel stated (5789-90), "I would have estimated 20c per ton-mile."

He assumed further a road repair cost of from $7,000 to $10,000, and he included in his basic costs 10% to 15% for outside costs (5791-92).

MR. SEARLS: Do you dispute the fact that there was a macadam road there prior to the time that they put the present asphalt surface on?

MR. GREENE: I understand that the road was not a well-surfaced road until the present road was installed, and that that was after 1913.

MR. SEARLS: The record shows that a macadam road was there.

MR. GREENE: I may be in error there; if I am wrong I will correct that.

THE MASTER: Mr. Hazen had something to say about the condition at the time. I have forgotten what it was.

MR. GREENE: I will look that up.

The only evidence which I find on the subject is that of Mr. Hazen, found at page 5856 of the transcript, on cross-examination:

"Q. Did you see the road running from San Mateo to Crystal Springs prior to 1914. A. I did.

"Q. What kind of a road was there then? A. Well, I have only a general recollection of it, but it was a country road that I think had been macadamed for the greater part, but was somewhat rutted.

"Q. All the hauling from Half Moon Bay is done over that road, isn't it? A. I don't know as to that; I think not all the way, certainly perhaps part of the way."

There may be other testimony in the record which substantiates Mr. Searls' contention that the road was macadamized prior to 1913. That was not my recollection of the matter.

MR. SEARLS: That was the testimony I had in mind.

The speed of his trucks is high, 5 or 6 miles an hour (5841), and as this bears upon the length of employment of the labor and the amount of work done by the truck within a given time, it is of fundamental importance.

He states further (5842) that increase in the distance to 4½ miles would involve an additional cost of approximately one-ninth, less the allowance for loading or unloading, which would not be changed.

For comparison, with his 20c figure, it may be noted that he says that he would not be surprised if the price for hauling from Milpitas to Calaveras ranged from 28c to 38c per ton mile, and

states that in some of his own hauling over heavy mountain roads the price ranged from 35c to 40c (5846-7).

He concluded his testimony, which was supplemented by Defendants' Exhibit 117, with the statement that he has never had a really similar job, but he presumes that this is an equitable figure for the cost (5850).

It is to be noted, first, that according to Bechtel's statements, as well as those of plaintiff's witnesses, motor trucks were not available until or about the year 1912, and they were not in general use until some time later than that date; second, that the hypothesis upon which Bechtel's evidence was based, that there existed "a good macadam road" built by the county, or parties other than the contractor, was not realized at the time of the actual construction of the dam nor during a portion of the rating period, and it does not seem probable that the county authorities would have gone to the expense of building a new macadam road for the use of the contractor to be cut up by the heavy teaming, as would inevitably have been the case, even though the contractor were to be charged with maintaining its surface, particularly when failure on the part of the officials to build this road might have the practical result of its being built at the expense of the water company, to the evident advantage of the public; third, that Bechtel under-estimated the rising grade, particularly the grade in proximity to the dam, and that his figures should have more nearly approached the Calaveras hauling figures. Finally, we submit that the witness' information and experience upon the cost of maintaining such road surface was much less than the plaintiff's witnesses, and that his allowance therefor was very inadequate.

Cement:

Hazen finds that the average price paid by the Spring Valley Water Company for cement purchases aggregating 26,000 barrels, during the years 1909-14, which are all of the years of which he

has records and upon which there was purchased any considerable amount of cement, to have been $2.13 per barrel f. o. b. cars near the company's work.

He assumes, however, that on a large order a somewhat more advantageous price could have been obtained during the rating period, and finally fixes his allowance for cement at $2 per barrel f. o. b. cars San Mateo, plus 24c for haul based upon a distance of 4.2 miles and 30c per ton mile charge, giving a total of $2.24 net per barrel upon the work, and upon the basis of the amount of cement used, 1.25 barrels per cubic yard of finished concrete, $2.80 per cubic yard of concrete (5414-17). He further cited the fact that upon the Spaulding dam $2.15 per barrel was paid for cement (5432).

Hazen also called attention to the danger that the low competitive prices might result in the west as they had in the east in the turning out of an inferior quality of cement, due largely to the fact that it was not held in storage long enough to be thoroughly seasoned (5415).

He also called attention to the fact that in making comparison of the cost of eastern dams, with those upon the Pacific Coast, there must be allowed a differential upon the cement of 65c or more per barrel, inasmuch as the average price of Portland cement during the past decade in the east had been approximately $1.35 per barrel, comparable with an assumed western price of $2 per barrel (5427-8).

Lippincott had had wide experience not only in the purchase of cement but in its manufacture, having had responsible charge of the cement mill, built and operated by the Los Angeles Aqueduct Commission during the construction of the aqueduct. He is "satisfied that there is a very tight and fast combination agreement on the selling cost for cement on this coast" (5469) * * * "Within the last year I have participated in the purchase of a considerable quantity of cement for the city of Santa Barbara, and have used every effort to break through that combination price

on cement, but have not been able to do so. * * * * I have no question at all but that the cost of manufacture of cement is very much less than the market price at which it is sold; but be that as it may, there is a rigid price for cement as far as my experience goes on this coast. It is something more than an engineering problem to be able to say whether that price of cement can be broken, or not. I could not break it'' (5470).

Incidentally, he refers to the fact that the cement companies cannot produce cement cheaply unless the mills are operated with a fairly constant output, the cost of operation being reduced very little if the cement is produced at less than the full capacity of the mill (5470-4).

He states that the city of Santa Barbara has been paying $2.10 to $2.12 per net barrel for some time, and that in the region of Los Angeles the prices during the past five or six years have been about $2.10 per net barrel f. o. b. cars.

He was also familiar with the prices which the Spring Valley Water Company had paid and finally fixed the net price $2.10 f. o. b. San Mateo, because that was practically what he had himself been paying for cement in his own work.

Lippincott states that in the construction of the Spaulding dam a price of $2.19 per barrel, f. o. b. Smart, was paid for 163,166 barrels of cement, which he thinks very likely corresponds to $1.80 at the mill, but (5521) ''the question of freight rates is about as mysterious a thing as the price of cement.'' ''I know that a road contractor, I think on the state highway, was very much distressed there last summer from the fact that he had to pay more for cement in Riverside than he would pay in Los Angeles, and it made quite a difference in his estimate'' (5518). ''Los Angeles has been buying at $2.10 to $2.15 per barrel net for the last three or four years.''

(5524) ''My idea about the prices of cement is one that has been in the process of formation through a period of years, and

irrespective of this table which I have here I have a judgment as to what the price of cement would be."

Dockweiler allowed for cement $1.57 per barrel f. o. b. San Francisco; 29c for warehousing, freight to San Mateo and lost sacks; 24c for hauling to dam; making a total of $2.10 per barrel delivered at the site of the dam, and at 1.24 barrels, $2.61 per cubic yard of masonry.

He cited, in Defendants' Exhibit 114, certain detailed records of prices paid upon the Los Angeles aqueduct, California state highway, Southern Pacific railroad, and refers to the Rolandi purchase in 1912 at $1.45 per barrel, f. o. b. San Francisco, on the authority of an off-hand statement of a salesman of the Pacific Portland Cement Company (5729-30), though Gay stated that the Stockton Street and Twin Peaks Tunnel cement cost $2.30 per gross barrel ($1.90 per net barrel) f. o. b. cars San Francisco (5819).

Dillman assumes a cost of $1.50 per barrel net at the mill, plus 10c freight to San Mateo (5698), for the cement, 5c haul, and the use of a mixture requiring 1.24 barrels of cement per cubic yard of masonry, making his cement cost $2.05 per cubic yard of masonry.

He cites as corroborative figures some Western Pacific Railway purchases of cement f. o. b. San Francisco in 1910 (but says that he did not use the Western Pacific costs) at $1.85 and in 1912, $1.70 net, and the Highway Commission purchases at $1.65 or $1.66. He has also heard and believed that there was a bona fide offer to furnish cement for the Hetch Hetchy dam at $1.30 a barrel f.o. b. San Francisco.

Positive evidence was introduced, however, showing that San Mateo prices would be greater than San Francisco prices by the freight differential of 14c per barrel, which even on a directly comparable basis would make the above figures for the Western Pacific $1.99 and $1.84 per barrel net, and for the Highway Com-

mission $1.79 per barrel, as was shown and will be referred to herein later in the testimony of George R. Gay.

None of the figures cited by Dillman were in fact corroborative, and his assumed cost of cement at San Mateo, $1.60 per barrel, is grossly in error, as was established by the plaintiff's witnesses Gay and Eastman, as well as Hazen and Lippincott.

"MR. McCUTCHEN (5929): Q. Do you know of any sales of cement in this market during the year 1913, we will say first, that warrants you in assuming that you could get cement at San Mateo at $1.65 a barrel—$1.60 it is?

"MR. DILLMAN: A. No, I don't know of any sales. It is just my general knowledge of commercial business and the cement business in particular that makes me believe that, and accept the figures that were shown here."

Newman for the defendant stated that the California Harbor Commission had paid but $1.64 per barrel for cement f. o. b. San Francisco, equivalent to $1.49 at the mill, plus 15c per barrel freight (5799, 6145).

As was shown later by his testimony (6115) and that of Mr. George R. Gay, this would be equivalent to $1.64, plus 14c freight differential, or $1.78 per net barrel f. o. b. San Mateo.

Nevertheless Newman did not consider this price, but based his unit cost solely on the prices paid by the Southern Pacific Railroad for cement, as he was trying to get at what, in his opinion, was the lowest price at which the cement could be purchased.

(5803) "MR. NEWMAN: * * * * My idea in getting out these tables [referring to Def. Ex. 116 showing prices paid for cement by the Southern Pacific Railroad Company] was to get a fair price of cement to a purchaser who had no agreement with the mill, but who would go into the market and try to get as fair a price as he possibly could."

We shall now show how very unfair it was for Newman to take the Southern Pacific Railroad, which controlled the cost of

its own transportation, as representing such a purchaser as was designated by him in this statement.

(6140) "MR. SEARLS: Q. Now, as I got the drift of Mr. McCutchen's question, he asked you what the price to the Harbor Commission was f. o. b. San Francisco, and then he called your attention to the fact that there was only 1c difference between that price in San Francisco and your price in San Mateo, whereas the freight differential is 14c; did you rely solely upon the price charged the Harbor Commission as a basis for getting your price of cement for this dam?

"MR. NEWMAN: A. I did not consider the Harbor Commission price at all. I considered the cost of cement to the Southern Pacific Company, and added to that the regular published freight rate from any of the mills in the vicinity to San Mateo, by which road the Southern Pacific would haul cement.

"Q. In considering the cost to the Southern Pacific Company, I think you stated on your direct examination that you eliminated those prices which were made because of the conditions of competition (6141) which have been described here. Is that correct?

"A. I eliminated one price of cement in Utah; that was out of the question. So far as the Southern Pacific Company was concerned, it could buy it there considerably less than what they paid for San Francisco cement. Another purchaser would have to pay more, because the freight rate would absorb the difference. There was another case in which the company got a favorable quotation from a mill, which I did not tabulate because it was so low it did not give a fair idea of the cost of cement on account of certain freight arrangements between the company and the cement company. There were also times when the Southern Pacific paid less than $1.40 and there were some times—not so many, when it paid more; but $1.40 was a fair average of the prices paid by the Southern Pacific for cement during this period, and I assumed that any other purchaser could have duplicated that price."

* * *

(6145) "MR. GREENE: Q. Was I correct in understanding you to say that your price that you named here was predicated entirely upon the prices which the Southern Pacific had paid during years past for cement?

"MR. NEWMAN: A. Yes.

"Q. Do you realize that the Southern Pacific has any advantage in the purchase of cement over other possible purchasers?

"A. It may over some, but I think with a contract of this size, requiring about 190,000 barrels of cement, that the cement companies would be willing to shave their prices to get the business.

(6146) "MR. GREENE: Q. * * * * I wanted to get your point of view and see whether you thought it was fair, in determining the average price over a series of years in taking a price of, if not absolutely the lowest, certainly among the two or three lowest prices which have been named in this discussion, and which the sellers of cement, themselves, name; does it seem entirely fair to you, in striking an average as to what it would cost during that time, to take figures of that kind?

"MR. NEWMAN: A. I was trying to get at what, in my opinion, was the lowest price that that cement could be purchased at. It struck me that if the cement companies will reduce the price to one consumer, there is not only a possibility but a strong probability that in a large order of this kind they will reduce it still more.

"Q. Do you appreciate any advantage that the railroad has in the purchase of cement over other competitors, I mean over other purchasers? A. I heard what the reason given was.

"Q. Does it sound reasonable to you? A. I don't know, I am not in the railroad freight business. That is a matter that is determined by them.

(6147) "MR. GREENE: Q. Are we to understand that it is your opinion that the fact that the Southern Pacific is engaged in the business that it is has no bearing upon the price which it has to pay for cement?

"MR. NEWMAN: A. It may have some bearing, but as to the arrangement between the cement mills and the railroad company, I know none of the particulars as to that.

"Q. You know the fact that they get a very low price, from the fact that they are in the business they are in, and with the facilities that they have, affords a possible explanation?

"A. Yes, that is possible, but at the same time my price was based on the assumption that the cement companies, in order to get that amount of business, would reduce their market rate sufficiently to meet that $1.40 figure."

We shall show later by the uncontroverted evidence of George R. Gay that Mr. Newman's assumption with regard to the probable action of the cement companies was not justified.

Newman finally assumed (5801, 5805) $1.40 net per barrel f. o. b. cars at the mill; 25c freight to San Mateo; 6c for handling two times, in unloading into warehouse and again onto teams; 17c for hauling; and 6c in unloading from the warehouse at the dam into the mixer; making a total of $1.94 net per barrel of cement in the mixer at the dam site.

George R. Gay, witness for the plaintiff, 40 years of age, resident of San Francisco, assistant to the president of the Santa Cruz Portland Cement Company and the Standard Portland Cement Corporation, who has been in that business for about six years and was familiar with the market prices of cement during the last seven or eight years (5816) stated (5824):

"THE MASTER: Q. Mr. Gay, if you had a request for a proposal on 250,000 barrels of cement, would the price be cut, say in 1913?

"MR. GAY: A. Your Honor, if that cement were to be used within a district where there is a nominal freight rate——

"THE MASTER: Q. San Mateo?

"MR. GAY: A. No, sir; there would not have been a cut. Suppose at the time that the flurry was in San Francisco, when cement could have been bought at $2.15 per barrel, if that business

had come up at that particular time, and we were able to close the contract while that price was in effect, we would simply add the freight from San Francisco back to San Mateo, which was 14c per barrel, and make a contract to furnish it at that price, $2.29 per barrel. We aim to get the market price for cement for all uses we consider legitimate for cement; for instance, if cement were to be used a long way off in the (5825) mountains, where there was a high freight rate, and where the engineers might be actuated to select some other kind of material if we could not furnish the cement at a reasonable price, considering the high freight rate, and the order was a large one, we might feel inclined to modify the price in some way; but in order to make a living profit out of the cement business, it is necessary that we get all the legitimate business that belongs to us at the market price."

Gay stated that the market price for cement during the rating period was almost uniformly $2.44 per barrel, being equivalent to the basic market price of $2.30 per barrel at San Francisco plus 14c railroad differential from San Francisco to San Mateo, though he states that for a short time, about two years ago, there was (5816, 5817, 5826) a little flurry in the market, during which cement sold at 15c below this price; that is, at $2.15 per barrel at San Francisco and $2.29 per barrel in San Mateo.

(5816) "MR. GAY: Our prices are all quoted in carload lots. The carload quantity is fixed by the railroad company. During the last seven years our prices at San Mateo have been almost uniformly $2.44 per barrel. * * * *

(5817) "That includes * * * * four sacks to a barrel, and those sacks are charged for at the rate of 10c each, equivalent to 40c a barrel; a contractor is allowed a credit of 10c each for sacks returned to the factory in serviceable condition.

"MR. GREENE: Q. And that price would apply as the fair market price during that period?

"MR. GAY: A. Yes. There have been very few deviations from that price for general work."

THE MASTER: That would make the price net at San Mateo what?

MR. GREENE: That would make the price at San Mateo $2.18. He says that $2.44 is the average, but taking off four sacks at 10c each would make it $2.04, and adding the freight differential it would be $2.18.

MR. SEARLS: The $2.44 includes the freight——

MR. GREENE: Yes, that is so. Is that the net or gross price?

MR. ELLIS: That is gross.

MR. GREENE: Then it would be $2.04; yes, I recollect that, that is correct.

In explanation of the low price at which the Southern Pacific Railroad Company has purchased cement during the past five or six years, Gay says:

(5817) "Any transcontinental railroad company into San Francisco can today purchase cement for $1.80 per barrel f. o. b. our mill. * * * *

"The reason for that is that their lines extend to factories in the east, and they are in a position to bring cement in here in competition with us."

As to the price at which the State Harbor Commission bought cement, $2.04 per gross barrel f. o. b. cars San Francisco, which would be equivalent to $1.64 net at San Francisco and $1.78 net per barrel f. o. b. San Mateo, Gay states:

(5818) "Our companies have not furnished any of that cement recently; we are not furnishing any cement to the state at that price. Why they got it, I don't know, but it has been running for some time. I don't know what explanation to make of that at all."

As regards the California State Highway Commission price of $1.80 gross at the mill (not at San Francisco, to which place the freight rate is 75c per ton or 15c per barrel), Gay says:

(5818) "That special price was granted with a view to en-

couraging the use of cement in the construction of the highways, that is, if our price for cement had been too high, the chances are that the engineers for the Highway Commission would have selected a different type of highway, a macadam covered with asphalt, or perhaps an asphalt with a rock mixture in it, or what they call asphalter concrete; we have succeeded in prevailing on the Highway Commission engineers to use a large quantity of cement, and with that in view, the price was fixed at $1.80."

* * * * * * * *

"Yes, we were trying to open up a new market. We are now and have from time to time sold a great deal of (5819) cement to the State Engineering Department, and it is all sold at the market price, for instance, at San Francisco at $2.30 per barrel." (He refers to "gross" figures.)

As to the low price quoted the city for the Hetch Hetchy dam work, $1.80 per gross barrel f. o. b. mill, Gay says (5819):

"When the question first came up of building the dam at Hetch Hetchy, our president took that question up with Mr. O'Shaughnessy and agreed to furnish cement on a basis of $1.80 per barrel f. o. b. the mill for the actual dam construction, providing cement was used in considerable quantities, rather than build a rock dam, but with a special provision that any cement furnished for other purposes, such as power houses, railroad culverts or the like, would be paid for at the market price, the going market price."

* * * * * * * *

(5820) "The established freight rate from our mill at Napa Junction and at Davenport, California, to San Francisco is 75c per ton; to San Mateo it is $1.25. The price at San Mateo, however, is based on the San Francisco price plus the local freight from San Francisco back to San Mateo, which is equivalent to 14c per barrel."

As to whether the prices of cement during the rating period had been affected by the construction of new mills and the entering of new corporations into the cement business, Gay stated (5820):

"Well, no, I cannot say that they have. Our market, of course, has been confined more than it was before the mills in Southern California were constructed, and the mills in Washington were constructed, but that has not affected the selling price of cement in San Francisco. There is one thing, however, I might add here, a new mill coming into the market might want to market its product, and in order to do so they may be able to place a lot of cement on the market at a lower price than the going market price, but that cement is not readily sought after, because it does not comply with the specifications by which cement is judged. * * * * It has not been proved, no."

* * * * * * * * *

(5821) "The city's specifications require that cement shall be continuous—not continuous, but in satisfactory use for a period of three years before they will accept it on their work."

Gay also cites the prices paid, by the contractors, for cement both upon the Stockton Street and the Twin Peaks Tunnel of $2.30 per barrel gross f. o. b. cars San Francisco (5819).

S. P. Eastman, vice-president and general manager of the Spring Valley Water Company during the past six years, states the company—

(5826) "Always uses a nominal amount for operating purposes. The largest one order that we have had occasion to place was for the flood water tunnel at Calaveras, and other small structures there. That order was placed in 1913, and there were used about 27,000 barrels. * * * *

"The matter of the order and the price was first taken up with all of the local companies. They submitted (5827) the same price, that is, $2.49 a barrel gross f. o. b, cars at Milpitas. At the same time, inquiry was made to learn if any imported cement was in the market, or was coming into the market at or near that time. We did not discover that any was coming in. When we learned that the price was the same from all factories, it was finally taken up with the Santa Cruz Company. They were asked

if they would make a better price, basing the delivery upon 100,000 barrels instead of 27,000 barrels. They said that that class of work would not warrant them in making any reduction. I asked them if there were any other inducements that might be made in placing the order which would afford a reduction, that is, whether we could take the deliveries at times that would be easier or less expensive for them to manufacture, if we could do that and get a better price, or if we could enlarge the order and give them our exclusive business for that delivery plus all of our deliveries for a period of two or three years, that we would be willing to do that; the answer that was made to that was that that class of construction was such that nothing but the market price could prevail. That was in June, 1913. They sent an executed contract covering the price, $2.49 gross, and from that time until October 1st, we had failed to get any better price and that price was executed and conformed with."

We have, then, the following comparison; I now present Table 31:

Table 31

Estimated Prices per Net Barrel (after deducting 40c. for sacks) Allowed by Different Estimators.

(1)	F. o. b. Cars Mill (2)	F. o. b. Cars San Mateo (3)	In bins Dam Site (4)	Cost per Cu. Yd. of Concrete (5)
1. Hazen	.....	$2.00	$2.24	$2.80
2. Lippincott	.....	2.10	2.40	2.89
3. Gay	.....	2.04	.....	(2.78)*
4. Eastman	.....	2.09†	.....	(2.83)*
5. Dockweiler	.....	1.71	2.10	2.61
6. Dillman	$1.50	1.60	1.65	2.05
7. Newman	1.40	1.65	1.94	2.40

*Found by adding to their price "f. o. b. cars San Mateo" the average of the difference in price allowed by each of the engineers between Col. (5) "Cost per Cubic Yard of Concrete" and Col. (3) "f. o. b. cars San Mateo," amounting to 74c. per cubic yard.

†Actual cost at Milpitas.

Sand:

Hazen allowed upon sand 60c per ton loaded at Niles and 25c freight to San Mateo; 15c for bunkering at the latter place; $1.25 for hauling 4.2 miles at a 30c rate; giving a total of $2.25 per ton of sand, which upon an allowance of 2,600 pounds of sand per cubic yard of masonry was equivalent to $2.94 per cubic yard of sand, and upon his basis of one-third of a yard of sand per yard of concrete—which he used here, because he assumed that a portion of the finer material would be obtained from the crusher dust and would be included in the price of the rock, though he stated that that was less than his ordinary practice—97c per cubic yard of concrete (5415-17).

He further called attention to the important fact that in comparison with the prices paid for sand upon the important dams built in the east, the Crystal Springs dam conditions involved an increased cost of approximately $2 per cubic yard of sand, or 67c per cubic yard of concrete (5420).

Lippincott estimates upon his sand 85c per ton f. o. b. Millbrae, 1.35 tons per cubic yard or 2700 pounds to the cubic yard, though his experience has indicated a weight from 2700 to 3000 pounds per cubic yard. He adds an allowance of 15c per cubic yard for unloading from the cars and $1.52 per cubic yard for hauling a distance of 4½ miles at 25c per ton mile. For the total cost of the sand he gets $2.82 per cubic yard, and using one-third of a cubic yard of sand per cubic yard of concrete, finds the cost of the sand 94c per cubic yard of concrete (5474-7, 5525-6).

Dockweiler allowed but 35c per ton at Niles, as against Newman's and Dillman's 55c and Hazen's and Lippincott's 60c per ton at San Mateo f. o. b. cars; $1.01 per cubic yard of sand in the bins at San Mateo; 97c per cubic yard for hauling, making a total of $1.98 per cubic yard delivered at the dam, and upon the basis of 0.34 of a cubic yard, an allowance of 67c per cubic yard of concrete,—materially lower than the estimates of defendants' other witnesses, as well as of plaintiff's witnesses.

Dillman allows 80c per ton, equivalent to $1.08 per cubic yard of masonry, upon mixed sand and gravel delivered f. o. b. San Mateo and assumes a weight of 2700 pounds per cubic yard. He allows in addition thereto $1.28 per cubic yard for hauling, based upon a freight rate of 20c per ton mile, 30c per cubic yard for bunkering at both ends; and 15c per cubic yard for forms; in all cases per cubic yard referring to the finished cubic yard of masonry and not of sand or gravel (5691-3). About one-third of a cubic yard of sand is used per cubic yard of concrete.

Newman allowed but 50c per ton for sand at Niles, plus freight 25c, unloading and bunkering charge at San Mateo 14c, hauling 71c, bunkering at the dam 4c, making a total of $1.64 per ton, which, based upon his allowance of 0.45 tons per cubic yard, gave his final figure of 74c per cubic yard of concrete (5803-6). Sand, he says, weighs about 2700 pounds per cubic yard (6128).

We have, then, upon the sand the following comparative estimates. I now present Table 32.

Table 32.

REPRODUCTION COST OF SAND

	Hazen (1)	Lippincott (2)	Dockweiler (3)	Dillman (4)	Newman (5)
At pit per ton f. o. b. cars	60c	60c	35c	55c	50c
At San Mateo per ton f. o. b. cars	85c	85c	60c	80c	75c
At Dam per cubic yard of sand	$2.94	$2.82	$1.98	$2.66	$2.22
At Dam per cubic yard of concrete	97c	94c	67c	89c	74c

Rock or Ballast:

Hazen made very careful examination as to rock available for the construction of the dam, and discussed the question with Mr. Schussler and W. B. Lawrence (5417). He says, "We found the

rock not of a very good quality, but as used it made a thoroughly good dam," and calls attention to the fact that in his "judgment it would be necessary in operating this quarry to reject a large amount of soft material interspersed with the better parts. The cost of handling this material which would be discarded is an element in the cost of the ballast per cubic yard delivered on the work. Taking that into account I reach 90c per ton, equal to $1.25 per cubic yard, and I think that is ballast of better quality than is probably obtained from similar quarries operating commercially in the neighborhood at the present time." (5417, 5439.)

He refers to the lack of suitable rock for plums, which involves a handicap for this dam, as compared with eastern structures, of upwards of $1 per cubic yard of masonry (5419).

Lippincott planned to use the quarry of metamorphosed sandstone, or trap rock, from which the rock was actually obtained, which he says is about a distance of three-quarters of a mile from the dam by wagon road, at a cost of 90c per cubic yard for quarrying and crushing; hauling (1.4 tons of rock one mile at 10c per ton mile), 14c per cubic yard; washing, 10c; total, $1.14 per cubic yard of concrete (Pl. Exh. 112, p 7; 5477; 5527-30).

Dockweiler allowed $1.02 per cubic yard of rock, quarried near the dam and delivered to the work, which, upon his basis of 1.02 cubic yards, gave $1.04 per cubic yard of concrete in place.

Dillman based his estimate upon the use of gravel, directly from the bank at Niles or Livermore, in place of stone, figuring 80c per ton f. o. b. San Mateo, and a weight of 2700 pounds per cubic yard, or $1.08 per cubic yard of finished masonry; allowing $1.28 for hauling to dam site; 30c for bunkering at both ends, per cubic yard of finished masonry (Def. Exh. 113, p. 1; 5691-2). This is equivalent to $1.08 per cubic yard for gravel.

Newman stated (6104) that the prevailing price for rock, suitable for concrete, delivered by barge, was 75c per cubic yard, and at San Francisco at the bunker $1.15 to $1.25 per cubic yard.

Nevertheless, he uses as his price for rock 71c per cubic yard, plus 17c haul, or 88c per cubic yard delivered at the dam site.

Counsel tried his best to qualify Newman as a competent judge of the cost of quarrying rock, through his having seen some quarries and talked with some of the men in them, but the task was in vain (6139), and the surprisingly academic character of Newman's estimate upon this rock is indicated by his allowance of but $2,200, or approximately 11% of the cost of his plant, for the making of ballast for 157,000 cubic yards of masonry (6131), and more important yet his admission that he assumed that every cubic foot of rock broken out of the quarry would be available for concrete, if not too fine or too coarse, and that for the material which was too fine or too coarse he allowed but 12%. He stuck to this in spite of having called to his attention the very large refuse pile at the quarry near the Crystal Springs dam on the road to San Mateo.

(6106) "MR. McCUTCHEN: Q. Assuming that there is a crusher there, and a great deal of rock had been crushed, and that a large percentage of that, on account of its character, and not on account of its size, has been found to be unsuitable for concrete, would you expect possibly to find repetition of those conditions at Crystal Springs?

"MR. NEWMAN: A. Not necessarily.

"Q. At any rate, you have not allowed for anything of that kind?

"A. No.

"Q. You have assumed that every cubic foot of rock broken out, if not too fine or too coarse, would be available for concrete?

"A. Yes.

"Q. And the 12% you have spoken of, that might not be available, is, as you have said, solely and only on account of the fact that it would be too fine or too large? A. Yes, sir."

Hazen, on the other hand, it will be remembered, referred to the large amount of waste observed at the quarries in this vicinity

and expressed his personal opinion that it would be necessary to reject a large amount of the soft material interspersed with the harder rock (5417).

Summarizing we have, then, the following comparative estimates upon the cost of the rock, or in Dillman's case, gravel assumed to be used in the reproduction of the concrete for the Crystal Springs dam:

Table 33.

REPRODUCTION COST OF ROCK

	Per ton of rock	Per cu. yd. of rock	Per cu. yd. of finished concrete
1. Hazen	$0.90	$1.25	$1.25
2. Lippincott	.....	1.14	1.14
3. Dockweiler	.....	1.02	1.04
4. Dillman (gravel)	.....	.....	1.08
5. Newman	.....	0.88	0.90(*)

(*) Note: Newman allows no waste in quarrying.

It will be seen that these figures run from 90c for Newman to $1.25 for Hazen. Attention is called to the fact that Newman allows for no waste in quarrying.

Forms:

English took his lumber cost from Dockweiler, $12.00 per M. (5634). He assumed that lagging 1″ in thickness, 6″ wide, and studding 2″ by 4″, all of No. 3 common lumber, would be adequate, that he would make his forms sectionally, and that he could use them over 10 times.

Imagine the lack of rigidity of forms made for a structure of this size upon which 500 cubic yards of masonry are to be placed per day, according to the estimates of the witness, with sheeting but 1″ in thickness, held in place by 2″ by 4″ studding, 20 feet long, wired together to prevent bulging (5621; 5628-9; 5634; 5675-8).

Newman, on the other hand, assumes that good lumber is necessary, and estimates upon No. 1 common lumber, though he uses light sheeting, 1¼″ thick, with bracing 2″ by 6″ (6109-10).

He assumes the use of the forms but once, and allows for them 480,000 feet B.M. at $18.69 per thousand feet B.M. for the lumber (equivalent to 6c per cubic yard of masonry) and $25 per thousand feet B.M. for the labor (equivalent to 8c per cubic yard of concrete) or a total of $43.69 per thousand feet B.M. (equivalent to 14c per cubic yard of masonry), and in addition to this 1c for nails, making his total allowance for forms 15c per cubic yard of masonry (6117).

Newman is unfair, however, in his allowance for labor, assuming that seven carpenters could do all of the work, and adding the ridiculous statement that three could do it (6117-18).

Hazen states that he has not made separate estimate upon the cost of forms, but under cross-examination gives his opinion that they could probably be built for from 40c to 50c per cubic yard of concrete, using good Oregon pine, formed and laid up in the way that he described as actually having been used in his Little River dam at Springfield, Mass. (5879).

He condemns the use of wiring to tie the forms together, as suggested by English, because on such large work which would necessitate wires 10 to 12 feet in length, the inevitable stretching would be objectionable, as it would permit the bulging of the forms (5879).

Moreover, he uses no such flimsy forms as outlined by English and by Newman (1″ and 1½″ in thickness for the sheeting; 2″ x 4″ and 2″ x 6″ respectively for the bracing,) using in accordance with his practice, and the standard practice with which he is familiar, 2″ planking, tongued and grooved or with bevelled edges, and 6″ by 8″ outside support (5880-2).

Lippincott assumes the use of rough Oregon pine purchased at San Francisco at $16 per M.F.B.M.; $1.00 per M. freight (60c per ton); unloading 25c; and wagon haul $1.86 making a total of

$19.11, or including framing at $15 per M., a total direct charge $34.11 per M.F.B.M. (5478).

Power:

For Power, English allowed the paltry sum of $3,140. (5635; 5643) Newman allowed $11,004 for this item, based upon a charge of 3c per kilowatt hour, 7c per cubic yard of concrete, on a total of 157,200 cubic yards, but even he admits that he has made no allowance for power factor, standby charges, cost of pole line, or other similar charges (5813).

Equipment:

English allowed for necessary equipment $22,803 (5651), a totally inadequate sum as evidenced not only by the estimates of plaintiff's but also of the defendants' own engineers.

Newman made allowance of $18,000 for machinery, and $27,000 for structures, or a total equipment allowance of $45,000 (5811; 6101), but was forced to admit that he did not know of any such low equipment charge on any work approaching this in magnitude; the only comparable figure which came to his mind being that of a job, which cost approximately a million and a quarter, in which the equipment cost was about $80,000, though he thought that in this particular job, error in the drawing of the specifications was to be held accountable for the expenditure of nearly one-half of this sum, which is significant of the hazard element always entering into large construction work.

Mixing and Placing:

Hazen allows $1 per cubic yard upon the mixing, transporting, placing and ramming the concrete in place, excluding the necessary forms, plant, equipment, bins, mixers, water supply, roads, tracks, false work, and conveying equipment, offices, houses, and the maintaining, renewing, and changing them during operation, for which he allows an additional $2 per cubic yard,—the cost of

the crushing plant being included under the cost of the rock or ballast,—and excluding further his allowance for contractor's profit or company's contingencies and costs, 98c per cubic yard (5418), making his grand total of these allied items $3.98 per cubic yard of concrete.

Hazen makes no direct allowance for his construction equipment for structures including that in his allowance of $2. The cost of his crushing plant is excluded from this figure and is covered in his unit price of crushed stone or ballast. It is to be noted further that he makes no independent allowance for power, which must also be covered by this item.

Hazen does not segregate his cost on forms, including it in his item plant equipment and structures.

Lippincott upon mixing and placing allows a direct cost of $1 per cubic yard of concrete, excluding his auxiliary or indirect costs, which he figures at 40% upon the materials, or $2.39 more.

He cites other dams upon which the mixing and placing charge, exclusive of the indirect charges amounted to $1.21 per cubic yard, 95c and 89c (5479-81), and states that he has assumed most modern methods developed to date, planning to use a number of towers with elevators placed along the upper side of the dam where the slope is almost vertical and the concrete raised through those towers and discharged onto the dam through the spouts, so that the vertical distance from which the concrete would be distributed through these spouts would not be too great (5482-3).

THE MASTER: What distance did he state as the limit, if you recall?

MR. GREENE: I haven't it here. I will look up the testimony.

THE MASTER: I am not sure that Mr. Lippincott stated it.

[The following is all the testimony of Mr. Lippincott on this subject which we have been able to find:

(5482) "THE MASTER. Q. In this mixing and placing do you assume all modern standard methods—you use mixers and conveyers and things of that sort?

"A. The most modern methods we have developed to date, yes. There really is only one method I am familiar with in placing concrete effectually, and that is a development of the last two or three years, the method of placing concrete in tunnels by compressed air. That has not been used in connection with my tunnel estimates, and I don't believe it would be used in connection with placing the concrete in this dam.

"Q. Outline briefly the way this dam would be built and the concrete mixed and put in place?

"A. The idea I had about mixing concrete and placing it in this dam is somewhat as follows, and it is controlled very largely by the fact that the dam is an arch dam. Your Honor has seen frequently in the city towers with elevators that were elevating barrels or skips of concrete and dumping the concrete into spouts and then the discharging of the concrete through these spouts into the walls of buildings. I have thought that in building this dam a number of those towers might be placed along the upper side of the dam where the slope is almost vertical and the concrete raised through those towers and discharged onto the dam through these spouts.

"Q. It would be mixed down there where the power house is now, wouldn't it, or on the other side?

"A. It would be mixed on the upper side of the dam and hoisted and then discharged through the spouts. Where dams are straight dams the most effective way probably is to handle the concrete by means of cableways and skips, and that is the way that is usually done. The large government dam that I spoke of handled their materials in that way. Where the dam is curved it introduces a problem of having your cables on a straight line and your dam on a curve, and it is rather awkward delivering the material. On these large government dams they had two or three cable ways over the dam and the concrete was hoisted and then put on these cableways and run out and then dumped into spouts and conveyed to the exact point in the dam

desired. That was my conception of how that might be done in this place.'']

Indirect or Auxiliary Expenses.

For purposes of comparison he makes analysis of the indirect costs on a number of dams with which he was personally familiar, and of which he had the detailed construction costs, amongst them the Los Angeles aqueduct 28.7% (excluding 5.3% general executive charges); upon a large government dam 44.3% or $3.61 per cubic yard; Gibralter dam 37.4%; Spaulding power dam 29%.

Lippincott observes further that in recent estimate for the city of Denver for a new water supply project he added 35% to cover indirect expenses, and upon an estimate for a large storm sewer for Santa Monica, just completed, he added 40% for indirect expense (5494).

Counsel for the defendant tried to make Lippincott's allowance for indirect expenses appear excessive by showing that the expenses incurred upon certain classes of items upon dams cited by Lippincott would not be likely to occur here, and that, therefore, the overhead expenses realized upon those structures should be reduced for application upon the Crystal Springs dam. The witness demonstrated the danger and the fallacy of Mr. Searls' hypothesis.

(5550) "MR. LIPPINCOTT: I do not say, Mr. Searls, that that [item of main road] would cost $21,000, or any other particular sum. But what I do say, and I say it because of an experience extending over about 25 years, and as the result of some pretty hard knocks, that there are 40% of incidental expenses that come into a piece of work like that that have got to be paid for, and they are just as much an expense in connection with the construction of a great piece of work as if it was money that was going into the structure itself. It has been my experience that unless you allow for things of that kind in your estimate, your

estimates are going to be too low, and you and your clients are going to suffer."

Referring again to his experience upon the Los Angeles aqueduct, Lippincott said:—

(5552) "MR. LIPPINCOTT: * * * My purpose in stating this is simply to show that no matter what kind of work we were doing, or wherever it was, far or near, we always had this black beast following us in the shape of an auxiliary expense that we had to pay for, and it was my job, it was my duty to keep track of the expenditure of money as we went along with this work, and every three months to make an estimate of how much remained to be done and how much money we had to do it with; we were thinking right down to the end that we were going to close out our work with a surplus of $1,000,000 or $2,000,000, and be in fine feather, and when it came to laying the last yard of concrete and closing the work up, we just came through without enough money left to publish a final report on what we had done, and the thing that did that was the fact that we were all the time having to pay for these unexpected things that cannot be foreseen."

Hazen fully substantiates Lippincott's point of view concerning the impossibility of anticipating all of the cost items likely to result, in the construction of such large works, in any way except by a percentage allowance or substantial allowance per cubic yard, and denies the implication of counsel for the other side that in applying the indirect charges, realized upon one piece of work, all of the items contained therein which appear as unlikely to arise in the work in hand, should be eliminated without addition for other items which do not appear in the comparable work, but which certainly will occur in the contemplated work, even though they naturally cannot be forecasted before construction.

(5891) "MR. HAZEN: The things that have to be done in

building one dam are never just the things that have to be done in building another dam. If you start out by excluding for the dam on which you are making an estimate all the expenses on the other dam that would not be incurred on the dam for which you are making an estimate, and stopped there, you would be certain to get too low an estimate, because where there would be some items omitted, it is absolutely as certain as anything can be in human experience that you will have (5892) some other items that would be greater.

"MR. SEARLS: Q. And that would probably result in things about balancing: Is that the idea? A. They are as likely to balance as to go up or down. Of course, if there are great inequalities, they can be taken into account, but ordinarily those things, within certain limits, are balanced."

Dillman estimates the cost of mixing and placing at but $1 per cubic yard. (Def. Exh. 113, p. 2) (5708) In addition to this amount Dillman allows 18% to cover profits, accidents and contingencies, incidents, etc., and in answer to counsel's question,—

(5709) "MR. SEARLS: Q. Is that taken as a function of the direct costs of the work or is that just an estimate which happens to be 18% of the direct costs?

"MR. DILLMAN: A. Well, ordinarily for an estimate of this kind, a contractor would add 15% for profit. If he knew he could make 5% he would be willing to do the work."—(another example of Dillman's preposterous assertions.)—"The extra 10% is to cover all contingencies, accidents, incidentals, bad luck, and this addition is about 18%. There is no special reason for the extra addition."

Newman (5809) allowed 97c per cubic yard for mixing and placing concrete, or including the labor on the forms $1.05 plus a superintendence and engineering charge of 6%, depreciation on equipment and machinery 23c; electric power 7c; and contingencies 10%; his total overhead allowance is $1.26 of which 47c therefore appears to be chargeable to the mixing and placing

item, including the power allowance; making the total mixing and placing allowance approximately $1.52.

If there be included with Newman's mixing and placing charge all charges other than those incidental to the cement, sand and rock, the total amount would be $3.38. This is comparable with a corresponding cost upon the Fort Mason tunnel work, upon which he gave comparative figures, of $5.75, as will be shown under the detailed analysis upon comparative data following hereafter.

He suggested placing the concrete from a trestle, level with the bunkers, with a maximum fall for the material of 140 feet, which he considered decidedly good construction! An amazing statement, though he hastens to add that if it were considered impracticable to drop the concrete from that height, an elevator could be built alongside of the mixer. It is to be observed, however, that he does not make allowance in his estimate for making or installing the elevator, or for the additional cost of placing the concrete from the foot of the elevator (6102-3).

Hazen, referring to this method of dropping or spouting the concrete through such great heights as suggested by Newman, stated:

(5875) "The spouting [upon his Springfield, Mass., dam construction] was not permitted to go very far, because in order to spout, with the equipment that we had, there was a tendency for the different parts of the concrete to get separated, and it was not possible to get them back again, and so while it would be permitted within certain limits, we did not permit it to go very far.

"THE MASTER: Does spouting from excessive distances result in a leaky structure or does it actually result in lack of strength, or both?

"MR. HAZEN: A. My experience with spouting has been limited. It has been suggested on various pieces of work and tried in a small way, but it has always resulted in this separation;

the sand and cement would get in one place and the balance would get in another. For that reason we have always stopped it before it went very far; but it is only fair to say that I have been told that the method has been developed of overcoming that, I think it is a patented method, which has been used on some pieces of work at the present time, and so far as that has happened and is available and tested out, I have not any prejudice against spouting.

"Q. That is, it would result probably in both these defects that I have mentioned? A. It has in my experience (5876).

"Q. I mean if it was defectively done it would mean both lack of stability and a tendency to leak? A. Yes."

* * *

"A. I might say in that connection that I have had, I think, quite an extended experience with new methods. At least half the pieces of work that have been carried out under my direction, some new method has been proposed and used, and the contractors commonly have been very optimistic about it, and have expected to cut (5877) their costs in half, and in some cases they have done very well, but in a great majority of cases the new methods have been disappointing, and in some cases they failed entirely, and we have had to fall back on the well established methods, and the contractor practically lost what he put into the new equipment; in other cases, the expected saving has not been realized and the work has finally cost pretty closely what it would have cost by standard methods. So that so far as I am concerned, I would make no estimates on improvements that have not been demonstrated in actual work. If a man thinks he can make a large saving by some new method that he has, and if he gets the contract on any work that we have, we are perfectly content to let him have all the profit that he can make by the saving on the first job. After he has demonstrated it and it is open then perhaps we will figure on it."

Hazen derives his basic figure of $9 per cubic yard upon the concrete masonry in the Crystal Springs dam and Howard cut in the following manner (Pl. Exh. 111, page 13 et al), which I will present as Table 34, covering cement, sand, stone or ballast,

Table 34.

Cement (5414-17) $2.00 per barrel; haul 24c, on basis 4.2 miles at 30c per ton mile, 1.25 barrels of cement per cubic yard of concrete	$2.80
Sand (5415-17) 60c per ton; freight 25c; bunkering at San Mateo 15c; haul $1.25, based upon 4.2 miles at 30c per ton mile, weight 2600 pounds per cubic yard of sand, giving total $2.94 per cubic yard of sand, with allowance one-third cubic yard per cubic yard concrete	0.97
Stone or Ballast (5417) 90c per ton, $1.25 per cubic yard of rock	1.25
Total for concrete aggregates	$5.02
Plant equipment, forms, etc. (5417-18) including maintaining, renewing and changing them during construction of the dam	$2.00
Mixing, transporting, placing and ramming the concrete (5418)	1.00
Management and contractor's profit, or contingencies, etc. if built by the company (5418)	0.98
Total cost concrete per cubic yard in place	$9.00

plant equipment, mixing, transporting, placing and ramming the concrete, management and contractor's profit, or contingencies if built by the company, giving a total of $9 per cubic yard of concrete in place.

Hazen makes analysis also of his allowance upon concrete upon other portions of the system than the Crystal Springs dam. They were all figures on like basis, except as to freight charges and cost of hauling. They indicate an everage cost upon the 5297 cubic yards in the Peninsular system $13.73 per cubic yard and upon the 18,915 cubic yards of the Alameda system $11.45 (5440-1), and it may further be noted that upon the Sunol filter gallery he estimated $10 per cubic yard for the single-barrel structures and $12 for the double.

Lippincott figures the cost of his concrete in place at $8.36 per cubic yard as follows (Pl. Exh. 112, p. 7):

Table 35.

Cement at San Mateo	$2.100	per bbl.	
Unloading	.040	"	
Hauling 4.5 mi. x 25c x $\frac{1}{5}$ ton	.225	"	
Handling at dam	.040	"	
Total cost per barrel	$2.405	"	
1.2 bbl. at $2.405			$2.89
Rock quarrying and crushing	$0.90	per cu. yd.	
Hauling 1 mi. x 1.4 ton x 10c on track	.14	"	
Washing	.10	"	
Total cost per cu. yd	$1.14		
1 cubic yard crushed rock at	$1.14		1.14
Sand f. o. b. San Mateo			
Screened 2700 lbs. per ton at 85c per ton	$1.15	per cu. yd.	
Unloading from cars	.15	"	
Hauling 1.35 tons x 25c x 4.5	1.52		
Total	$2.82		
$\frac{1}{3}$ cu. yd. at $2.82			.94
Mixing and placing			1.00
Total direct cost per cubic yard			$5.97
Indirect costs 0.40 x $5.97			2.39
			$8.36

Newman (Def. Exh. 116; 6119) finally arrives at a figure of $6.49 per cubic yard of concrete for the Crystal Springs dam and Howard cut, as follows, as shown on Table 36, which I will now present.

Table 36.

Cement, f. o. b. Mill, $1.40; freight 25c, handling 6c; hauling 17c, handling 6c; total $1.94 x 1.24 bbls.	$2.40
Sand, per ton at Niles 50c; freight 25c; bunkering 14c; hauling 71c; bunkering 4c; total $1.64. Sand weighs 1.33 tons per cubic yard x 0.34 cubic yard, or 0.45 tons per cubic yard concrete	0.74

Crushed Rock, stripping 4c; drilling and blasting 7c; loading 15c; transporting 4c; crushing 12c; bunkering 4c; equipment 11c; maintenance and repairs 10c; hauling 17c; bunkering 4c; total 88c x 1.02 cubic yard	0.90	
	$4.04	$4.04
Lumber, $18.69 per M. F. B. M. x 3.06 F. B. M. per cubic yard concrete	0.06	
Nails, Water, Oil and Waste	0.08	
Total Material including Lumber for forms	$4.18	
Labor, Forms 480 F. B. M. at $25, 8c; mixing, placing and tamping, 77c; maintenance, labor and materials, 20c; total labor	1.05	
Field Overhead, Superintendence and engineering, 6% of $5.23, 31c; depreciation on equipment, 50% on machinery and 100% on structures, 23c; road construction and maintenance, 6c; power, electric, at 3c per K. W. Hr., 7c; contingencies, casualty, etc., 10% of $5.90, 59c; total	1.26	2.45
Grand Total	$6.49	$6.49

We have referred to the inadequacy of this statement by reason of,—first, his under estimate of the cost of cement, based as it was solely upon the incomparable Southern Pacific Railroad cement prices; second, his low sand costs as compared not only with the estimates of plaintiff's engineers, but also with those of the defendant; third, his low hauling costs; fourth, his inadequate allowance for forms; fifth, his underestimate of the cost of rock, growing out of his negligence of obvious and existing quarry waste; sixth, his totally inadequate allowance for mixing and placing concrete, and for overhead and contingent expenses; seventh, by comparison with his own Fort Mason experience in which he admitted that the tunnel and retaining wall concrete cost $8.55 per cubic yard upon the basis of the Crystal Springs concrete proportions and which with his admitted allowance for rock and for the increased cost of sand has been shown to amount to $9.48, and if the proper allowance for cement be added, 30c per barrel, to $9.86 per cubic yard. The latter figure, $9.86, is

comparable with his assumed figure of $6.49 per cubic yard of concrete, except in so far as correction should be made for the difference in the relative magnitude of the two structures. We submit that Newman has himself demonstrated, in his admissions when under cross-examination upon his Fort Mason tunnel work, the unfairness and inadequacy of his Crystal Springs dam estimate and that he has demonstrated the fairness of Hazen's estimate.

Dockweiler's estimate of the reproduction cost of the concrete (Def. Exh. 114, p. 1) in the Crystal Springs dam is $6 per cubic yard. The figures are given in the following table.

Table 37.
Crystal Springs Dam

		Cost per cubic yard of concrete
1. **Sand,** per cubic yard in bins San Mateo	$1.01	
Hauling	.97	
Delivered at Dam, 0.34 cubic yard of sand at	$1.98=	$0.67
2. **Crushed Rock,** quarried near dam and delivered to work, 1.02 cubic yard crushed rock at	$1.02=	1.04
3. **Cement,** cost per barrel S. F	$1.57	
Warehousing freight to San Mateo and lost sacks	.29	
Hauling to dam per barrel	.24	
Cost per bbl. delivered 1.24 bbls. at	$2.10=	2.61
		$4.32
4. Mixing and placing, including forms,		
(a) Equipment cost per cubic yard	$0.21	
(b) Direct labor, mixing and placing	0.50	
(c) Power, oil, waste, etc	0.03	
(d) Forms, etc	0.08	
(e) Liability Insurance	0.03	
	$0.85	
5. Field Overhead, Supervising Office Expenses	$0.07	
6. Profit and Contingencies	0.76	$1.68
Total cost per cubic yard, in place		$6.00

In passing, it is interesting to note that one finds in Dock-

weiler's figures the same errors of underestimating most seriously the labor costs that Hazen said are characteristic of the young and inexperienced engineer.

Dillman estimates the cost of the concrete for Crystal Springs dam at $6.90 per cubic yard, as shown by the accompanying table, No. 38.

Table 38

	Cost per cubic yard of concrete in place.	
Cement f. o. b. San Mateo $1.60 per barrel net; hauling 5c 1.24 bbls. per cubic yard	$2.05	
Gravel and sand f. o. b. San Mateo 80c per ton 2700 lbs.	1.08	
Hauling sand and gravel to dam site	1.28	
Bunkering sand at both ends	.30	$4.71
Forms	$0.15	
Mixing and placing, including labor, power, water and equipment charges on mixing and placing machinery	1.00	
Total direct costs	$5.86	
Add about 18% to cover profits, accidents and contingencies, incidents	1.04	2.19
Total, per cubic yard		$6.90

And he made further estimate based upon the use of concrete with 25% of plums, increasing his weights from 3200 to 4000 lbs. per cubic yard (5702) as follows:

	Per cubic yard of masonry
Cement $1.60 per barrel by .93 of a barrel	$1.49
Gravel and sand ¾ of above amounts	.60*
Hauling, ¾ of amount, add 1¼ times the above price	1.20
Bunkering as above	.30
Forms as above	.15
Mixing and placing, ¾ of amount	.75
	$4.49
1000 lbs. of plums	.40
Hauling	.40
Placing	.25
Total in place	$5.54
*Note this is an error, as ¾ of $1.08 would be 81c	.21
	$5.75

We may now assemble and summarize these segregated items of the cost, per cubic yard, of the finished concrete, in place in the dam. That is shown, your Honor, in Table 39. This table shows the various witnesses who testified upon this subject, and their estimates, and I think it is clear without further explanation. There are some notes here which should be taken into consideration in considering the specific statements.

[Table inserted opposite]

Dillman's Recurrent Substitute Basis.

Space forbids our discussing the matter in detail, but we cannot refrain from calling your Honor's attention to the further evidence of Dillman's inclination to consider substitute methods of construction, less thorough in their nature than those actually apparent in the structures to be valued, as evidenced in his extraordinary theory that sound hydraulic practice dictated the desirability of building masonry dams with an impervious skin on the upstream face and porous below this. When asked for special examples of the construction of a dam upon this principle, he is, of course, put to it to find one, though he is of the impression that dams have been built with extreme care to get the upper 10 feet in width of section as nearly impervious as possible and leaving the remainder of the section of good but pervious material, as he puts it (5701; 5927-9; 5930-40).

The careless method which Dillman proposes for dumping plums into the concrete to cheapen it, gives further evidence of his mental attitude (5940-46), as do his comments upon his approximate methods of figuring and "finnicky supervision * * * in excess of the needs of the job" (5948-9).

(5928) "MR. DILLMAN: A. So far as the quality of the concrete is concerned it is of excellent construction and I have never heard anybody contend otherwise. For that matter I can say the same thing of all of Mr. Schussler's work, he did exceptionally good work.

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Table 39.

Summary of Reproduction Cost Estimates upon Concrete (per-cubic-yard in place) in Crystal Springs Dam.

	Cement	Sand	Stone	Total of aggregates for concrete delivered at dam site	Remaining Items: Labor, mixing, and placing forms, equipment, power	Total per cubic yard of concrete
(1)	(2)	(3)	(4)	(5)	(6)	(7)
For the Plaintiff						
1. Hazen Pl. Exh. 111 p. 13.....	$2.80	$0.97	$1.25	$5.02	$3.98	$9.00
2. Lippincott Exh. 112 p. 7.....	2.89	0.94	1.14	4.97	3.39	8.36
3. Gay (5816 et seq.).....	2.78*	.....	.....	.....	.....	.....
4. Eastman (5826 et seq.).....	2.83*	.....	.....	.....	.....	.....
For the Defendant						
5. Dockweiler Def. Exh. 114.....	2.61	0.67	1.04	4.32	1.68	6.00
6. Dillman Def. Exh. 113.....	2.05	.....$2.66**.....		4.71	2.19	6.90
7. Newman Def. Exh. 116.....	2.40	0.74	0.90 ⁂	4.04	2.45	6.49
8. Newman Fort Mason Tunnel figures (5814 et seq.).....	1.64 ⁂ ⁂	Practically nothing.	1.45 (approx.)	3.09	5.05†	8.14
9. Ditto corrected to Crystal Springs proportions (6121 et seq.)..	2.05	"	1.45 (approx.)	3.50	5.05†	8.55
10. Ditto with corrections shown, covering increased cost of materials.....	2.43	.74	1.64	4.81	5.05†	9.86

*Found by adding to their price "f. o. b. cars San Mateo" the average of the difference in price allowed by each of the engineers between "Cost per Cubic Yard of Concrete" and "f. o. b. Cars San Mateo" amounting to 74c per cubic yard.

⁂ ⁂ $1.49 f. o. b. mill.

⁂ **Without** allowance for waste in quarry, which Hazen says was, **in fact,** heavy, and his statement stands uncontroverted.

** Dillman allows for the sand and gravel at the dam site, $1.08, plus hauling $1.28 plus bunkering 30c; total $2.66 per cubic yard of concrete.

† Newman states this to be $5.75 but we think that some of the items included by him were chargeable to the materials.

"MR. McCUTCHEN: Q. Now, you don't propose to do as good work as that, do you?

"A. I do propose to do as good work as that in this estimate, but if I had the designing and the supervision of the construction there are a great many things which have added expense there which I would not do."

(5929) "Q. Do you propose to make as good concrete as that?

"A. Only a portion of it as good as that. * * * * Understand, Mr. McCutchen, in this estimate, I do, but I say if I had the designing and the supervision of the construction of that dam I would not make it all of as good concrete as this."

Weight of Concrete and Aggregates.

Dillman's free and easy method of substituting arbitrary assumption and assertion for accurate analysis and determination of fact was nowhere better illustrated than in his position upon the weight of concrete.

The importance of this and the consequences which may be involved by it, are indicated by the fact that his assumptions in regard to the weight of materials required for concreting the 157,200 cubic yards of the Crystal Springs dam, result in their underestimate by him to the extent of 20%.

When Dillman first stated his basic assumptions with regard to the weight of the aggregates entering into one cubic yard of concrete, such as that of which the Crystal Springs dam is built, the soundness of his data was immediately challenged by Hazen.

This controversy led to serious issue; the discussion will be found at the following pages:

(5693-4) "MR. HAZEN: It seems to me Mr. Dillman has not material enough to make his concrete in this estimate. How much does a cubic foot of concrete weigh?

"A. A cubic foot of concrete weighs about 130 pounds.

"MR. HAZEN: How much?

"A. About 130 pounds. It depends on the material of which it is built.

"MR. HAZEN: We have never accepted anything less than 150. Your figures check pretty nearly with 130, but I thought that was short.

"A. I have never made concrete that way, 150 pounds to the cubic foot. I have never seen concrete made that way, 150 pounds to the cubic foot. I have weighed some concrete to get that information, and I have never weighed concrete that weighed over—it figures a specific gravity of 2 1-6—that is about 133 pounds.

(5693) "MR. HAZEN: I have also weighed a great deal of concrete, and I think I have never weighed it on my work less than 148, and from that up to 155. We have regarded anything below that as inefficient.

"THE MASTER: I suppose you can weigh a cubic foot of that material down there.

"A. There is a good deal of difference in the weight of rock and sand. I have taken this 2700 pounds to the cubic yard of mixed material; that is more than a cubic yard of sand would weigh; it is more than a cubic yard of gravel would weigh. Moreover, in the finished yard of concrete, you would not use a full yard of gravel, and a corresponding amount of sand—you would get a greater bulk; the material shrinks some from the aggregate, but it takes something like .9 of a cubic yard of ballast, and say 1-3 to 1-2 a yard of sand, and a barrel of cement, to make one yard of the finished product. The 2700 pounds also checks my experience; it also checks information that I got from the Niles Gravel Company—Niles Sand & Gravel Company, I think it is. I got this over the 'phone, and have accepted it as being correct. If it is wrong, my figures are wrong to that extent;

but the effect would simply be to reduce the contractor's profits, not to eliminate them or effect loss."

* * * * * *

(5695) "The material hauled per yard of concrete would be the 2700 pounds of sand and gravel, 500 pounds of cement, which would make 3200 pounds; the additional weight of the finished concrete would be the water in crystallization, which would make the finished concrete weigh something more than 3200 pounds.

"MR. HAZEN: Do you know how much that is, Mr. Dillman?

"A. No, I don't know just how much water would be used; it would not all remain, anyway.

"MR. HAZEN: I mean the amount that remains.

"A. I could look up the authorities, but I would just as soon take your word for it as read a pocketbook.

"MR. HAZEN: It is about 30 pounds to a barrel—30 pounds of water that stays with the cement.

"A. That is all that would stay; that is all there is to it.

"MR. SEARLS: What is the matter now, Mr. Hazen, don't his figures check?

(5695) "MR. HAZEN: It seems to me he has not gotten nearly material enough to make a cubic yard, Mr. Searls.

"MR. SEARLS: According to this there would be 2700 pounds of sand and gravel, and 500 pounds of cement.

"MR. HAZEN: And 30 pounds of water.

"MR. DILLMAN: From the best of my information, that will make a yard of concrete.

"MR. SEARLS: I thought you said 30 pounds of water to a barrel?

"MR. HAZEN: It would be 1 1-4 times 30 — 37.

"MR. SEARLS: That would be very close, would it not?

"MR. HAZEN: Figuring it at 150 pounds per cubic foot is 4050 pounds per cubic yard.

"MR. SEARLS: He says he has taken 2700 pounds for the sand and gravel in a cubic yard of cement, isn't that right?

"MR. HAZEN: Yes.

"MR. SEARLS: There is a little less than 500 pounds of cement, and I suppose the water would make up the rest. The 3200 pounds very nearly checks.

"MR. HAZEN: It does not check. There is 2700 pounds of sand and gravel and 500 pounds of cement and 38 pounds of water; that is 3238 pounds. Now, if the work weighs what I think it ought to, what I think this dam does weigh, 4050 pounds per cubic yard, we are 800 pounds short. In other words, you have only got .8 of the material.

"MR. SEARLS: It checks his own figures as to weight of the finished product, if he says 3200 pounds to the cubic yard of concrete.

"MR. HAZEN: 3200 pounds per cubic yard would be 118 pounds per cubic foot, instead of 130.

"MR. DILLMAN: As I have said before, I have never seen concrete that weighed 150 pounds to the cubic foot; that is, I never have seen it weighed. My information about this is directly from the gravel pit, and I believe it is correct."

* * * * * * *

(5699) "After I left here last night I phoned the Niles Gravel Company and they say that their gravel mixed including gravel and sand for a cubic yard of concrete, weighs between 2600 and 2700 pounds. I want to say too that I got another quotation from the Grant Gravel Company and they say that their gravel mixed coming from the Livermore Valley will weigh between 2900 and 3000 pounds. They will guarantee it in all cases never to overrun 3000. Rhodes—Jamison, Manager, informed me this morning that the gravel mix and the crushed rock mix that they put on the market for concrete weighs between 2800 and 3000 and has never exceeded 3000 pounds. So much for late quotations. I have looked over the books—

"MR. GREENE: Q. Is that the gravel in the car or in concrete?

"A. That is the gravel in the concrete, the gravel and sand in the concrete.

"Q. In the concrete? A. Yes."

* * * * * *

(5701-2) "MR. SEARLS: Q. Mr. Dillman, I would like to ask you whether the concrete in the east, where they use this heavy iron rock frequently would not probably weigh more than the concrete made here with a lighter weight rock?

"A. I think that is true. I think that our Pacific Coast rocks contain less mineral and therefore the gravel or the crushed rock would weigh somewhat less than they do in the east; but the very heavy concrete that is cited in cyclopean masonry, which takes in from 25 to 40% of boulders, absolutely solid. Now, these weigh more per unit of volume than any concrete that is made. Moreover, in this dam the concrete would not necessarily be much compacted. The upstream face of this dam would be compacted but except for a depth from that upstream face of about 10 feet the structure would be safer if the material were not compacted; in other words, the seepage that got through that face should drain off without creating pressure elsewhere, in order to follow out the hydraulic principle, part of which is, any seepage or leakage getting through your hydraulic tight base should be so released as not to do damage elsewhere. If this dam were made tight at the downstream face and not at the upstream face, on the ordinary analysis, the dam stresses would not apply at all, and the so-called gravity section dam, uniform section, on that analysis would prove absolutely unsafe by the mathematical analysis resulting from a tight downstream face instead of a tight upstream face. Moreover, it does not need to be compacted. There is no frost here to get in and disintegrate the concrete by the action of water getting into the downstream face, and I do not believe that it would be very seriously compacted, and I do not believe the concrete would weigh as much

as it does in the east; but, for the sake of following out this argument I have made an analysis this morning of material for a dam, using Mr. Hazen's weights, which are in excess of anything that we would have on this case, of about the following: I consider that there would be 25% in volume and approximately the same in weight of plums in the concrete."—(That is Dillman's first reference to plums.)—"This mixture would be just as rich as the mixture we were talking of yesterday. Then for 75% of concrete, including 25% of plums the analysis would be as follows: Cement, $1.60 per barrel, at three-quarters of the 1.24, .93 of a barrel equals $1.49 for cement. The gravel and sand at the same price, three-quarters of the amounts, would be 60 cents per cubic yard. Hauling the same amount times one and a quarter, which is allowing that my weights were only 80% of the 4000, by three-quarters of the amount, would be $1.20 for hauling. Bunkering, just the same, 30 cents; forms, just the same, 15 cents; mixing and placing, 75 cents. That is $4.49, for the concrete portion of a cubic yard of concrete. Now, 25% of plums will weigh 1,000 pounds, and they would cost San Mateo considerably less than the sand and gravel, but I have put them at the same price; that would be 40 cents; material at San Mateo, hauling at the same rate, 40 cents, and placing at the same rate—some of them would go through the mixture and some would not; that would be 25 cents, making $1.05 for plums. So this makes a yard of concrete $5.54 in place in the dam at actual cost. This is accepting Mr. Hazen's weights and all other allowances correspond.

"MR. HAZEN: Q. How much sand and gravel was in that, Mr. Dillman?

"A. There is three-quarters of the amount that I assumed yesterday.

"MR. HAZEN: How much was that?

"A. That was 80 cents a yard, three-quarters of a yard.

(5703) "Q. How much in weight was the three-quarters of a yard?

"A. The weight I have not considered until I got to the hauling. The weight is considered as 4000 pounds, the plums being one-quarter of that in volume, approximately 1000 pounds.

"MR. HAZEN: The materials that you had in a cubic yard of concrete yesterday weighed 118 pounds a cubic foot and if you took off one-quarter of that and then added 25% for plums, isn't the shortage you had yesterday still there?"

(I call your Honor's attention to the fact that while Dillman did not say that this weight was 118 pounds, he did not deny Hazen's statement to that effect, and if you take the aggregates that are there, any engineer will find they do reach 118 pounds, —although Dillman subsequently denied it.)

"A. No.

"MR. HAZEN: Can we get some schedule to see how the 4000 pounds is going to be made up?

"A. You can juggle figures a great deal about this; you can make all sorts of figures. At the same time there is no rational figure that you can make that will make this cost of concrete seriously greater than here. In other words, there is a margin, a leeway in all these figures for considerable change in conditions, and the $1.04 which I added yesterday for profit, contingencies and so forth, would reduce on this analysis to $1.46, so that in that $1.46 there is still plenty of leeway for any allowances whatever that are to be made to suit your conditions.

"MR. HAZEN: If you have 118 pounds of material, to make a product that weighs 150 pounds, there has got to be a serious advance on something.

"A. No concrete ever weighed 150 pounds except with a considerable proportion of plums.

"MR. HAZEN: Now, I have weighed a great deal of concrete; I have not my records with me because I did not think they would come up. The concrete that in our practice weighs fully 150 pounds is concrete without plums; when plums are added

it weighs more, but we have not weighed it. The eastern concrete is no heavier than the local concrete; we happen to have some information as to what concrete weighs, out of this particular gravel that you are talking about. These tests were made for another purpose, and are dated November 3, 1915. This report is made by Robert W. Hunt & Company, on 6 by 12 blocks of concrete made from this gravel.

"MR. SEARLS: Just a minute. Where were these weights taken?

(5704) "MR. HAZEN: In San Francisco.

"MR. SEARLS: From what structure?

"MR. HAZEN: From samples of concrete that is being placed at Calaveras, at the present time, made from this sand and gravel.

"MR. SEARLS: Do you say it is the same mix?

"MR. HAZEN: I will give you two different mixes.

"MR. SEARLS: I cannot see how it would be relevant, unless you are going to use the same mix that was in the Crystal Springs dam.

"MR. HAZEN: The mix makes hardly any difference in the weight per cubic foot; that is a matter of compacting material. The specific gravity of the material is all about the same; it makes very little difference in the weight whether the mix is one thing or another.

"MR. DILLMAN: Isn't the specific gravity of cement considerably more than sand and gravel?

"MR. HAZEN: Practically identical, both 2.65.

"MR. DILLMAN: I thought it was somewhat heavier and therefore a richer mix ought to weigh more.

"MR. HAZEN: We have never found it so in our experience.

"MR. DILLMAN: The compactness of an ordinary block of concrete (5705), which is compacted for the purpose of weighing, is greater than the average compactness of concrete in a structure.

"MR. HAZEN: We think it is the other way. We think in small tests like this it is impossible to get the proportion of stones in, and that it weighs considerably less than it does in the structure, but we have asked Mr. Lawrence to cut a piece out of the Crystal Springs dam and weigh it this morning.

"THE MASTER: I made that suggestion a little bit in joke.

"MR. GREENE: We thought it might as well be determined definitely.

"MR. SEARLS: I suggest that we wait then until we get this record.

"MR. GREENE: I would like to have this data in.

"MR. SEARLS: I object to its introduction upon the ground that it does not pertain to the structure here and therefore is immaterial, irrelevant and incompetent.

"THE MASTER: You do not object to its hearsay character, the fact that he obtained the record from R. W. Hunt & Company?

"MR. HAZEN: I have the original record here.

"MR. SEARLS: I have no objection on that ground.

"THE MASTER: I will overrule the objection.

"MR. HAZEN: These we believe represent less per cubic foot than the actual work, because of the small size of the specimens; they were made for another purpose than to obtain this incidental information from them, but on the richer mix used in the base of the tower at Calaveras the first sample showed 148 and the second sample 143, and the poorer mix which was used in the facing of the dam, the first sample showed 148 and the second 145½; this is all gravel and sand concrete.

"MR. SEARLS: Where was the gravel and sand obtained from?

(5706) "MR. HAZEN: From Calaveras Creek.

"MR. SEARLS: That isn't from the same place at Niles that you expect to obtain the sand and gravel for the Crystal Springs dam?

"A. It is not from the same place, but it is from the bed of the same stream and I believe it is practically identical material.

"THE MASTER: I suppose you had better give the proportions of the mix in the two samples there.

"MR. HAZEN: The first two samples were about 1-2-4, from the base of the tower and the second two samples were about 1-3-6 from the facing of the dam.

"MR. GREENE: Those are in the same order, in your last statement, as they were in your first consideration of them?

"MR. HAZEN: They are."

* * * * *

(5707) "MR. SEARLS: I think, your Honor, we are going to get a whole lot in the record which does not pertain to the case at bar. I suppose if the Crystal Springs concrete weighs up as Mr. Hazen says it does, that settles it."

The discussion led the plaintiff to have Lawrence cut out a block of concrete about 2 feet square, from the crest of the Crystal Springs dam. This block was then taken to the Bryant Street yard. After inspection of the block, its specific gravity was determined by experiment by Hazen and Metcalf, in the presence of Dillman, Dockweiler, Greene and Sharon, by methods for determining the specific gravity, which the plaintiff's engineers stated were in common practice, and which will be found described at page 5893 et seq. By this method its weight was found to be equivalent to 151 pounds per cubic foot. Dillman objected to the method used, claiming that it was inaccurate. The block was trimmed and a cubic foot found to weigh 150 pounds.

(7126) "MR. HAZEN: After our experiment last fall, and in order to eliminate any possible criticism as to the method of determining weight, the large block on which the experiment was made was cut in several pieces, of which Mr. Dillman had one, and one of the large pieces was taken to a stone cutter and he was directed to cut out a cubic foot. The stone cutter worked on it for some time and cut a cube of the material, but it was

more than a cubic foot; he intended to trim it exactly to a foot, but it was such hard work that he gave up before he got it down, so that the dimensions overrun; but it can be measured exactly as it stands, it is good, true shape. That block has been standing in the shed out at the yard, under a good roof, and in a dry place, for perhaps six weeks more or less. Last night a number of us went out and Mr. Dillman measured this block, and we wrote down the figures that he measured. Mr. Metcalf weighed it. The weight calculated from those figures is 150 pounds to the cubic foot. The whole block, as we measured it originally, coming in from the rain and without drying it, we measured 151 pounds. After six weeks standing in a dry place on a shelf and measuring a cube of it in a way about which there cannot (7126) be any possible question, and which can be checked by anyone interested, it comes out 150 pounds to the cubic foot. That material has not been calcined, as Mr. Dillman's specimen was. I think it is as dry as concrete ordinarily ever gets, and it was as dry as I should ever think of ever having it when weighing it to determine that."

Subsequently Dillman made independent tests of two portions of the block, after drying it thoroughly with an electric furnace, with a result which he claimed indicated a weight of 141 pounds per cubic foot, and Hazen claimed between 142½ and 144 pounds per cubic foot on Dillman's own statement and after thorough heating to a high temperature (7118).

Dillman then made some small laboratory specimens of concrete, 1-foot cubes, to the size of which plaintiff's engineers objected on account of the difficulty of getting a fair specimen in so small an amount. These blocks Dillman stated weighed 150 and 151½ pounds per cubic foot immediately after mixing, and some weeks later, 146½ and 147½ pounds per cubic foot (7161-4).

Thus it will be seen that Dillman was driven, step by step, from his original assumption of a weight of 118 pounds per cubic foot of aggregates in the concrete, upon which his inventory was clearly based, to 130 lbs.; then 141 lbs. per cubic foot; and finally

146½ to 147½ lbs. as the weight of his electric-furnace-dried specimens; and 150 to 151½ lbs. as the weight of his wet specimens,—the actual concrete (block) out of the dam weighing 151 pounds per cubic foot.

MR. SEARLS: I think you are in error in the statement that his inventory was based on that weight.

MR. GREENE: I didn't mean that he prepared any inventory, but the estimate that was inserted in the inventory, Mr. Searls, was based on that weight.

MR. SEARLS: You will remember that he made his estimate and then analyzed it afterwards at the request of Mt. Steinhart and myself.

MR. GREENE: I am willing to leave that explanation just as you have made it.

MR. SEARLS: Well, I know it is the fact, if that is of any assistance to you.

MR. GREENE: I meant that we would take that statement as entirely satisfactory.

Space forbids a lengthy discussion of this subject, but we give below a concise statement of the various weights assumed by the different witnesses and found by test (with reference to the record), and content ourselves with allusion to the facts, that defendant's own witness Dockweiler based his estimate upon an allowance equivalent to 148½ lbs. per cubic foot, Newman on 150 lbs. per cubic foot; and that the average of the figures used by Hazen, Lippincott, Dockweiler and Newman amount to 151 lbs. per cubic foot—identical with the weight of the block cut out of the dam, as determined by plaintiff, Dillman claiming its weight to be 141 lbs. as the result of his laboratory experiment on a very small specimen, after driving off, by heating to a high temperature in an electric furnace, as much of the moisture as possible contained in the block. I think this table speaks for itself. It is simply a summary of what I have just been stating. I present Table 40.

Table 40.

Tabulation of Weights of Concrete per Cubic Foot as Determined by Different Witnesses.

Record Page			Pounds per cubic foot
5693-4	1.	**Hazen** weighed a great deal and found it to run between. Regarded everything below that inefficient.	148–155
7129-2	2.	Hazen figured on a weight of	150
5473	3.	**Lippincott** gave only the weights of rock 2800 lbs. cubic yard and sand 2700-3000 lbs. per cubic yard.	
5525	4.	He gives 1 cubic yard rock, ⅓ cubic yard sand, 1.2 bbls. cement as necessary for 1 cubic yard concrete. This is equivalent to 4190 lbs. per cubic yard or	155
5704-7	5.	**R. W. Hunt's Testing Laboratory** tested a number of small blocks (in connection with another matter) made from concrete in use at the Calaveras Dam during the previous year—small specimens 6″ x 6″ x 12″ showing a weight on a 1:2:4 mix	148–148
		and on a 1:3:6 mix	145.5–143
5735	6.	**Dockweiler** gave weights of aggregates without water of 3966 lbs. per cubic yard and with water 4015 lbs. per cubic yard of concrete, equivalent to	148.5
6127-8	7.	**Newman** gave weights of aggregates 3600 lbs. plus cement 450 lbs., total 4050 lbs., equivalent to	150
5665-8	8.	**English** gave weights of aggregates upon which the weight of rock was clearly in error, but which we cite for completeness, rock 2500 lbs., cement 400 lbs. per barrel, sand 2700 lbs. He says weight of all in 1 cubic yard of concrete 3600 lbs. equivalent to	133
5696 7161	9.	**Dillman** used weights of aggregates equivalent to. Though he says that he did not say 118 lbs. per cubic foot (7118; 7125; 7161).	118
5693	10.	He did in fact erroneously state his weight per cubic foot was	130
5906	11.	At another point he gives the specific gravity 2⅛ equivalent to	133
5906	12.	At another point he gives the specific gravity 2⅓ (at Oregon City) equivalent to	145

5923 13. Later he is "a little in doubt," then "concedes," then is "satisfied" that 300 lbs. cubic yard should be added to his estimated weight of aggregates making 3500 lbs. per cubic yard of concrete equivalent to..... 130

5909-10 14. **The specimen block** approximately cubical and 2 feet on a side, cut out of the crest of Crystal Springs Dam by Lawrence, weighed according to the test of the Plaintiff engineers 151

7118 15. According to Dillman's test after drying out in an electric roasting oven..... 141

7119 16. According to the Hazen interpretation..... 142½–144

7161-4 17. Dillman's laboratory blocks, approximately a cubic foot weighed, he said, when wet 150–150½

18. Some weeks after drying..... 146½–147½

We submit that the fair allowance for the weight per cubic foot of aggregates has been proven to be not less than 150 lbs. per cubic foot, and that Dillman's estimates are, therefore, clearly 20% below the reasonable weight of aggregates, and that this affects his costs, not only in the amount of aggregates but also in the hauling and other incidental charges.

Comparable Data Upon Concrete Dam Costs.

Hazen cited the contract costs per cubic yard (including cement) paid for concrete in twelve of the largest masonry dams built comparatively recently of cyclopean masonry, calling attention to the fact that the prices which he cited were not strictly comparable and did not cover anything except the concrete; thus, the masonry in the Waschusett dam of the Metropolitan Water Board of Boston cost $4.60 per cubic yard, whereas, the supplementary items contracted for added $1.42, making the total contract cost $6.10, and the final total cost of the dam $7.72 per cubic yard. This is presented in the form of a table, as follows:

Table 41.

In the following, where cement is separately supplied, the cost of the cement is added to the price bid. Where there are several classes of masonry all have been added up and the average price for the whole dam has been used.

Dam	Bids received	Approx. date of construction	Distance to R. R. miles	Rock for plums	Cubic yards	Average price per cubic yard
Kensico	.....	1909–15	0	Available	997,000	$4.41
Ashokan	.....	1907–12	2	do	810,000	6.00
Wachusett	.....	1900–04	0	do	287,000	4.60
Cross River	.....	1905–09	1	do	138,000	6.80
Hartford	.....	1914–15	0.5	do	78,600	4.12
Columbus	.....	About 1904	(1)	do	56,000	4.94
Loch Raven	1912	.....	(1)	do	45,000	5.42
Pittsfield	.....	1910	.....	do	42,600	6.05
Alexandria, Va (no information)	1913	.....	.....	.....	17,500	5.50
Springfield (cost of completed work)	.....	1908	7	do	12,427	7.97
Holyoke (contractor failed)	.....	1911	About 3	do	7,100	4.12
Crystal Springs Dam (Estimated by A. H.)	.....	1910–12	4.2	Not available	163,000	9.00

Hazen reviews the cost of the more important large dams built in this country in recent years, calling attention to the local handicaps (5419-20) of the Spring Valley Water Company, and this is presented in the form of a table which we will now present as Table No. 42.

Table 42.

	Per cubic yard of concrete
Hauling	$0.90
Absence of Plums	1.00
Excess cost of sand at $2.00 per cubic yard, on one-third cubic yard of sand per cubic yard of masonry	0.67
Total	$2.57
Deduct allowance upon hauling, counted twice on sand	0.50
Net handicap, say	$2.00

Hazen further calls attention to the greater cost of cement in the west than in the east, which amounts to 65c per barrel or 48% and to the greater cost of labor during the period within which the dams under discussion were built, amounting to 50% (5428).

Applying the latter percentage of increase to the average cost of 11 dams cited, which amounted to $5.45, and adding the $2 handicaps, he finds the comparative cost of the masonry approximately $10.12, indicating that his assumption of $9 per cubic yard was somewhat less than upon the above basis.

It is not necessary to quote here the discussion given by Hazen concerning the conditions under which the work was executed upon these various dams. Suffice it to say that he showed (Pl. Exh. 111, p. 8) that "The average price per cubic yard of the eastern dams of recent construction is as follows," which we present as Table 43:

Table 43.

4 dams	100,000 to 1,000,000 cubic yards each	$5.45
4 "	30,000 to 100,000 cubic yards each	5.12
3 "	Under 30,000 cubic yards each	5.86
11 dams, price per cubic yard		$5.45

I am reminded at this time that we had no explanation from Mr. Dillman on his second assumption, made after the introduction of the question regarding concrete was made, as to where he was to obtain his plums, or what the cost of getting them to San Mateo might be. He figured on the hauling cost from San Mateo, but as far as I am informed in the record—and I may be in error about this—I think even on that basis we have no further data than that to which I have referred.

MR. SEARLS: Didn't Mr. McCutchen clear that up on cross-examination? It seems to me he developed that what the witness had in mind was the large sized rocks gotten from the gravel pits.

MR. GREENE: That may be, Mr. Searls, but I didn't find it in the record.

MR. SEARLS: You will find it at page 5940 of the transcript.

MR. GREENE: I will now present a table, which I will call Table 44, and it is simply a copy of what is found in Mr. Hazen's exhibit 111 showing the total comparative cost of $9.36.

Table 44.

(Pl. Exh. 111, p. 8)

"Making another comparison, the average contract price on 4 large eastern dams was	$5.45
Add handicap for lack of railroad, sand and quarry	2.00
Corresponding price for direct comparison would be	$7.45
Add increased cost of cement, $2 instead of $1.35, 65c per barrel, on 1¼ barrels	0.81
Comparative figure, including increased cost of cement but not increased cost of labor	$8.26
Add for increase in labor cost, taken very roughly at $1.50 per cubic yard Eastern conditions, 50% increase in California	0.75
Total, including allowance for increased cost of cement and increased cost of labor	$9.01
Add profit, 10%, on $3.55 additional cost	0.35
Total Comparative Cost	$9.36"

Hazen also stated that it was his judgment that the cost of the Spaulding dam, spillways and two small auxiliary dams was

approximately $7.92 per cubic yard, exclusive of engineering or interest. The dam having been built at a period of low costs, he concluded finally (5433) "It was my judgment that $9 per cubic yard was a fair estimate of the cost of reproducing this dam during the period from 1907-14."

Again (5890), under cross-examination he estimates the equivalent Spaulding dam costs at $9.10 per cubic yard, and finally state (5951) that on obtaining further information of the completed costs of the structures he finds that the costs were slightly higher than the figures which he had mentioned.

Hazen makes a further helpful comparison of the relative cost of materials, of labor, and of hourly prices paid the labor under eastern and western conditions, in his Pl. Exh. 111, pp. 11 to 13a.

Upon the seven eastern examples cited, he finds the average cost of materials entering into the concrete to be $3.20 per cubic yard, varying from $2.75 to $3.35, excepting one case (Washington, D. C.) in which it reaches $4.42; as against like estimates for the materials in the west upon the Spring Valley works ranging from $4.17 to $5.62 per cubic yard. Upon the cost of labor he finds for the east an average price of $4.07 per cubic yard with variations in the seven examples cited from $2.24 to $5.38.

Lippincott submitted comparable figures upon a large number of masonry dams built in this vicinity (Pl. Exh. 112, p. 24), showing the following total costs, including direct and indirect or auxiliary charges, and I present this as Table 45.

Table 45.

	Cubic yards	Total cost per cubic yard on all work upon the dam
Sweetwater	20,507	$11.40
Elephant Butte	600,000	7.75
Roosevelt	342,000	8.99
Crystal Springs, original cost	157,200	12.35
Large power dam (Spaulding)	153,806	9.15
Stoney Creek	12,202	15.93
Large Government Dam (Incomplete structure)	256,018	5.67
Gibraltar	5,160	12.20
San Carlos	94,730	10.97
Riverside	186,147	10.70
Gibraltar	42,250	9.00
Gibraltar	52,394	8.50
Pine Flat	485,000	8.06
Stoney Creek	13,900	13.37
Crystal Springs (Lippincott reproduction)	157,200	10.49 ※

※ This cost it is to be remembered is the entire cost of the dam, Lippincott's estimate upon the cost of the concrete alone being $8.36 per cubic yard.

Newman submitted data concerning the cost of the concrete of the Fort Mason tunnel, built in 1914 by the Board of State Harbor Commissioners for the Belt Railroad (5814), which was in marked contrast to his estimate (6119) of $6.49 per cubic yard for the concrete in the Crystal Springs dam.

MR. SEARLS: It was not introduced in evidence for comparison with the Crystal Springs dam, either.

MR. GREENE: Well, perhaps it would be more proper to say that it was developed on cross-examination. That was an unintentional misstatement on my part.

The Fort Mason tunnel work was divided into three groups: First, the regular tunnel excavation; second, digging trench, pouring concrete lining and backfilling; third, building the retaining wall (5814).

The contract price on the tunnel and the retaining wall, excepting the arch and portals, was $6.50 per cubic yard, excluding cement, or including the same, at $1.64 per cubic yard, a total of $8.14 per cubic yard based upon the use of a 1-3-6 concrete mixture.

The gravel used upon this work was delivered at $1.45 per cubic yard, which he says involved an advantage of but 19c over his Crystal Springs dam estimate, and the sand cost "practically nothing" (6121).

He admits that on the basis of the proportions used on the Crystal Springs dam, the Fort Mason tunnel masonry would have cost, on the contract prices, $8.55 per cubic yard (and on the basis of the culvert work $7.05 per cubic yard), and if there were added to this price the advantage admitted by him upon the gravel, 19c per cubic yard, which we claim is too low, and for the sand which cost practically nothing on the Fort Mason tunnel, 74c per cubic yard, which was allowed by him on the Crystal Springs dam work, we should have a total cost of concrete of $9.44 per cubic yard, fairly comparable, we submit, with his allowance for the Spring Valley work of but $6.49 per cubic yard.

Furthermore, he admits, under cross-examination, that if he deducted the cost of the cement, gravel and sand from the contract price paid for the Fort Mason concrete, there would be left the sum of $5.75 per cubic yard to cover the labor and materials incident to the mixing and placing the concrete, including the lumber and work upon forms, whereas, upon the Crystal Springs dam he allowed $3.38 made up of labor of mixing and placing $1.05, lumber 6c, overhead $1.26,—all per cubic yard of concrete; this leaves an unaccounted difference of $2.37 per cubic yard (6122).

Newman attempts to explain away this difference of $3.38 per cubic yard (after deducting an allowance of 8c per cubic yard for miscellaneous items) by his statement that the contractor

"made $2.65 per yard" (6123), assuming further, that the unaccounted remainder of 65c, represents the difference in the difficulty of the jobs.

We submit that no such argument can fairly be made. In the first place, the witness included no allowance for the contractor's general administrative and office expenses (6142); he admits that he does not know the character of his office force or its cost; that he has never seen the books of the contractor; that the contractor had not had any other work with the Board of State Harbor Commissioners upon which he made such a profit, and that he had no particular knowledge of the organization of the firm.

Is it reasonable to suppose that the State Harbor Commission, with a chief engineer as experienced as Newman, would have let this work by contract upon a basis showing to the contractor a profit of $2.65,—equivalent to 41% on a contract price of 6.50 per cubic yard (excluding cement which was furnished to the contractor by the Harbor Commission),—had it believed that it could save the contractor's profit by doing the work by day labor? Or is it reasonable to believe that competition failed to limit the profit to a narrower margin than 41%? Is it not, on the other hand, more reasonable to suppose that Newman's guess as to the contractor's real profit was, in fact, altogether too large, and his estimated cost of the work to the contractor correspondingly too small, as so often happens when the final cost figures have to be estimated instead of being taken from the books?

We submit, that the witness not only had no adequate ground for assuming a contractor's profit of $2.65 per cubic yard of concrete, or 41%, but that the facts clearly indicate that he underestimated the cost to the contractor of doing the work and that no such deduction may be fairly made in determining the fair cost and value of that work.

We submit further, that Hazen's theory,—that it is reasonable to suppose that work would be done by contract, provided only

the contractor could save out of the cost, which would otherwise be incurred to the company, a margin of profit attractive to him,—is the only sound and reasonable one and that we have no choice in this case, but to assume that the Harbor Commission acted in good faith in its execution of this work by contract, after competitive bidding, and that the fair and equitable cost of the Fort Mason work is measured by the final contract payments plus any additional costs involved to the commission, and not by Newman's theory of its final cost decreased by the contractor's profit.

Under redirect examination (6142) Newman attempted further to explain away the damaging comparison,—which he had been forced to admit,—between his estimates for the Crystal Springs dam and the actual cost of the Fort Mason tunnel work,—by stating that he estimated the total cost of the work on a 1-3-6 mix at $6.30 per cubic yard, including the cement, or subtracting $1.60 for the cement $4.60 per cubic yard (note the error in subtraction); and upon the basis of the Crystal Springs mix $6.98 and $4.93 respectively. These after thoughts, however, shed no new light upon the problem, nor do they materially alter the facts previously outlined.

We submit, that upon a cost comparable to that of the Fort Mason tunnel, Newman should have figured $8.55 per cubic yard, plus corrections for gravel and sand of at least 19c (admitted) and 74c (allowed by Newman at Crystal Springs), respectively, making a total of $9.46 per cubic yard, instead of $6.49 per cubic yard; and this is without the correction for Newman's unfair allowance for cement, which we submit should be increased by the sum of at least 30c per barrel, or 39c per cubic yard, making the total amount on the Fort Mason tunnel basis $9.86 per cubic yard. Admitting even that some correction might be necessary to adapt the Fort Mason tunnel figures to the Crystal Springs dam, the difference between this amount, $9.86 per cubic yard, and Newman's allowance of 6.49 per cubic yard is so great as to

clearly indicate the unfairness of his basic estimate, and to substantiate the judgment of plaintiff's engineers.

Hazen made detailed comparison (5433-36; Pl. Exh. 111, pp. 9 and 10) of the original cost of the construction of the Crystal Springs dam reported by Wenzelburger ($2,242,688.92) with his reproduction cost estimate. From Wenzelburger's total he deducted Sharon's allowance for lands and rights $263,000, and raising the dam in 1890, $34,041, leaving a remainder of $1,945,000, excluding the cost of raising the crest in 1911, amounting to approximately $10,000. He says that the records are not in such shape that it is possible to compute from them prices per cubic yard of masonry, in fact, there are no unit prices in the statement. He, therefore, made the comparison by adding to his reproduction cost of structures $1,746,160, his 15% ($261,000) to cover engineering, supervision, administration and legal expenses, getting a total sum of $2,007,000; comparing this sum with the actual cost $1,945,000 he finds a difference of but $62,000 or 3.2%. Therefore he justly concludes:

(5436) "From the above comparison the original cost of construction was practically the same as the present estimated cost of construction.

"In connection therewith the following changes in prices may be noted:

"(1) The labor cost at the present time is considerably greater than was the actual cost.

"(2) The cost of California cement at the present time is very much less than was the actual cost of the imported cement that was used.

"(3) The cost of labor and teams for hauling the materials from San Mateo to the dam site were less than would be corresponding costs at the present time. On the other hand, the use of motor trucks greatly reduces the cost as compared with what it would be if done by the methods originally used."

THE MASTER: Didn't Mr. Hazen use motor trucks?

MR. GREENE: All that appears in the record, that is, the only reference which we have been able to find, is to the use of motor vehicles by Mr. Hazen, although he refers to the fact that those were not in use prior to 1912, as does Mr. Dockweiler.

"(4) There have been improvements in machinery and methods for handling work of this kind, and these would result in substantial savings as compared with the methods that were originally used.

"To sum up: On present evidence it appears that all the above tendencies have about equalized and offset each other, and that the estimated cost of building the dam at the present time is practically the same as the actual cost of construction 25 years earlier."

We submit that this is a significant confirmation of the fairness of Hazen's estimate of the cost of reproducing the Crystal Springs dam, and that no proof has been introduced by the defendant which would justify reducing this original cost, before making use of it as a fair measure of its true present value, as a structure.

MR. SEARLS: You have not been solicitous about using the original cost of structures before, Mr. Greene?

MR. GREENE: And we are not solicitous about using it now except as a valuable check.

THE MASTER: Mr. Greene, how do you compare Mr. Lippincott's $8.36 and Mr. Hazen's $9.00?

MR. GREENE: I think you can only do that, your Honor, on the basis, first, of all of the material costs which appear in the record and which are subject to comparison; and second, with the final costs which include Mr. Lippincott's addition of 40%.

THE MASTER: $8.36 includes 40%?

MR. GREENE: That is what I mean. I don't think there is any method of comparing the two except in the original material costs and then jumping from those to their final estimates. I don't assume that on the detail of it it would be fair to have to

take Mr. Lippincott's 40% and compare that with Mr. Hazen's figures on the specific items, your Honor, although it might be.

THE MASTER: Does Mr. Lippincott include a contractor's profit?

MR. GREENE: He does not.

THE MASTER: If you add 10% for contractor's profit, it would bring it above Mr. Hazen's figures, would it?

MR. GREENE: Yes.

THE MASTER: There is another check in the record at some point to equalize the 40% indirect and Mr. Hazen's inclusions in overhead, is there not?

MR. GREENE: Yes sir. I was coming to that in the discussion of overhead.

MR. SEARLS: I understand though that Mr. Lippincott's indirect costs included items which he himself specifies would not be included if the job were done by contract. So you cannot flatly add 10% to his figure for that reason.

MR. GREENE: You will recall that Mr. Lippincott says that if the dam were to be contracted he did not think it could be contracted at his figures because he had reckoned on doing it in the same way that the work on the aqueduct was done; so whatever you find to be a fair contractor's profit would have to be added on to Mr. Lippincott's figures.

THE MASTER: Mr. Searls thinks there is something in the $8.36 that would not be there if a contractor were doing the work. Is that the idea, Mr. Searls?

MR. SEARLS: Yes.

MR. GREENE: That may well be. I have not thought of that.

MR. SEARLS: There would be field overhead and things of that kind.

MR. GREENE: That may be quite true, Mr. Searls. We take it that that is fairly represented by the difference of $100,000 between Mr. Lippincott's estimate and Mr. Hazen's.

THE MASTER: $100,000 in the whole dam?

MR. GREENE: Yes.

Brickwork.

We have already discussed brickwork costs under "Tunnels" and shown what we think is the inadequacy of the defendants' estimates, not only by plaintiff's estimates, but by the comments by defendants' own most competent witness, J. J. Phillips, who, it will be remembered estimated the fair cost of the outside brickwork on the Peninsula and Merced system, which was not of difficult construction, at $25 per thousand and the tunnel lining at $36 per thousand, indicating clearly that as the difficulty of forming the brickwork increased, its price per cubic yard would also increase.

The relative estimates of the engineers for the plaintiff and defendant, upon brickwork outside of the tunnels, upon many different structures in the plant of the complainant, is indicated by the following tabulation of Hazen's and Dockweiler's figures as typical,—Dillman's figures upon brickwork, so far as they can be segregated, closely following Dockweiler's. Now I will present Table 46:—

[Table inserted opposite]

The average of Hazen's figures amounts to $30.59 per M. upon 5743 M. brick (comparable with Hazen's Plaintiff's Exhibit 111, pp. 23, 24, $30.58 upon 6034 M. brick) (5409); whereas, Dockweiler's figure upon the same structure is but $21.72.

Dillman's allowance for cement in brickwork is inadequate; he uses but one-half of a barrel per yard of brickwork, whereas both Hazen and Metcalf state that they have found that 8-10ths of a barrel is required on a 1:3 mix, and a barrel and a half on a 1:2 mix (5535-8).

Hazen made further comparison on brickwork costs in Plaintiff's Ex. 111, pp. 14, 15, 16, 23, 24, and gave a very interesting discussion relating to the difficulty of getting union labor to lay

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Table 46.

COMPARISON REPRODUCTION COST ESTIMATES

Upon the more important Brick Masonry Structures of the Spring Valley Water Co.
Exclusive of Overhead and Interest-during-Construction allowances,
As of Dec. 31, 1913

Inventory		NAME	Quantities 1000 Bricks	Hazen		Dockweiler		Dillman	
Pg.	Str.			Unit	Total	Unit	Total	Unit	Total
1	2	Pilarcitos Dam, Gate House, Waste Way.	153	38	$5,818	$23.00	$3,521	.....	.....
1	2	Pilarcitos Dam, Waste Chamber.....	22	46	1,021	29.25	649	.....	.....
3	16	" " Forebay and Gate House.	90	38	3,403	23.50	2,104	.....	.....
14	3	San Andreas Gate Tower.....	120	26	3,128	21.50	2,586	.....	.....
20	3	" Pipe Line, old Tower.....	258	40	10,324	22.25	5,743	.....	.....
25	3	Crystal Spgs. Gate Tower and Stand Pipe	544	36	19,591	21.75	11,836	$25	13,605
25	4	Crystal Spgs. Dam Intake Pipes.....	207	50	10,360	37.75	7,822	25	5,180
26	5	Crystal Spgs. Outlet Tunnel.....	323	30	9,678	23.25	7,500	25	8,405
32	3	Crystal Spgs. Upper Dam, Waste Tunnel	306	50	15,290	25.00	7,645		.....
32	2	Crystal Spgs. Gate House and Shaft.....	46	36	1,670	30.50	1,415		.....
79	2	Niles Aqueduct.....	435	25	10,880	23.50	10,227		.....
208	6	Lake Merced Drainage Conduit.....	486	30	14,580	24.50	11,907		.....
208	2	Lake Merced Dam.....	71	30	2,136	21.75	1,549		.....
208	9	Lake Merced Forebay and Gate Well...	41	25	1,025	22.25	912		.....
210	20	Lake Merced Upper (Colma Drain Sys.)	214	30	6,420	23.25	4,976		.....
219	10	Univ. Md. Res. Forebay.....	46	30	1,371	.....	.....		.....
219	11	Univ. Md. Res. Tunnel.....	67	30	1,997	22.75	1,515		.....
227	21	College Hill Tunnel.....	27	40	1,086	21.25	577		.....
229	7	Lake Honda Res.....	786	20	15,720	23.00	6,318		.....
230	14	Lake Honda Res. Outlet System.....	104	30	3,135	.....	2,195		.....
236	40	Lake Honda Res. Sewers.....	104	30	3,126	26.50	2,761		.....
236	43	Lake Honda Res. Sewers.....	397	30	11,922	26.50	10,531		.....
239	1	Potrero Hts. Res.....	115	30	3,456	23.50	2,707		.....
244	1	Lombard St. Res.....	125	22	2,751	23.50	2,938		.....
			170	30	5,123	22.75	3,885		.....
247	1	Francisco St. Res.....	171	22	3,762	21.75	5,894		.....
247	1	Francisco St. Res.....	66	22	1,452	23.50	5,053		.....
247	1	Francisco St. Res.....	100	22	2,200	.....	.....		.....
247	1	Francisco St. Res.....	149	22	3,278	.....	.....		.....
		Totals.....	5,743		$175,703		$124,766		
		Average per.....	M		$30.59		$21.72		

$20 to $25 per M in place.

Allen Hazen Pl. Ex. 111, p. 23-24-$30.59 as above.
Allen Hazen (p. 5409) gives 6034 M $184,512=$30.58 per M.

water-tight brickwork in Portland cement mortar, and called attention to the fact, admitted also by Phillips, that it is (5452) "a great deal harder to lay brick with Portland cement than it is in lime mortar, and in specifications of bricklaying the number of brick that a man will lay, based on lime mortar, is not applicable to Portland cement work. * * * The lime mortar is smoother and it pushes home a good deal easier, and it does not get hold of the man's hands; so it is pleasanter work" (5449-5455).

We submit: first, the fairness of Hazen's figures upon the reproduction cost of the Crystal Springs concrete dam and appurtenant structures ($1,754,176) is conclusively proven; second, the original cost was within 3½% of Hazen's estimate,—it should be of controlling importance in view of Hazen's forceful statement that (Plaintiff's Ex. 111, p. 10) "on present evidence it appears that all of the above tendencies have about equalized and offset each other, and that the estimated cost of building the dams at the present time is practically the same as the actual cost of construction 25 years earlier"; third, Lippincott's estimate gives substantial confirmation of Hazen's figures; fourth, Dockweiler's lack of experience (and when Dockweiler is referred to English is included), as well as the obvious unfairness of their figures upon the various items cited, debar their joint estimate, of $1,195,493, from consideration; fifth, Dillman underestimated the fair cost of cement by fully 40c per cubic yard of concrete,—involving an approximate omission of $65,000 based upon the combined yardage of Crystal Springs dam and Howard cut; he underestimated the weight of his concrete aggregates by 20%, involving an omission of approximately $238,000; and at other points in his estimate failed to do justice to the company; sixth, Newman underestimated the cost of the cement by at least 30c per barrel ($49,000), basing its cost primarily upon his Southern Pacific Railroad figures, which it was shown by the uncontroverted evidence of Gay were incomparable and impossible of realization by any except another transportation company similarly situated; allowed no

quarry waste, which existed in fact, and for which he should have allowed at least 25% in excess of his allowance of 10% to 12% for excessive coarse or fine material,—which involved an omission of $36,000—25%x90x163,000 cubic yards—and failed, further, to cover the cost of quarrying, as evidenced by the other estimates and by experience at the Calaveras dam; grossly underestimated the labor, mixing and placing, and other similar items, as appears by comparing his allowance therefor of $2.45 per cubic yard of concrete, with his statement of cost on his Fort Mason tunnel work, $5.75 per cubic yard,—though we figure it as $5.05 on the basis of his statements concerning segregated items,—a difference which would involve a further sum of approximately $375,000 as applied to 163,000 cubic yards in the Crystal Springs dam and Howard cut; seventh, defendants' engineers underestimated brickwork, as evidenced not only by the plaintiff's estimates, but also by the testimony of defendants' most experienced witness, the contractor, J. J. Phillips, whose estimates thoroughly substantiate Hazen's figures; eighth, defendants' engineers also underestimated the cost of concrete upon structures, other than the dam, for reasons similar to those cited above as applying to the Crystal Springs dam.

Finally, we submit that the fair allowance for this group of structures,—"6. Crystal Springs Concrete Dam and Appurtenant Structures,"—should be fixed at Hazen's figure, $1,752,276. This sum excludes an item amounting to $1900, covering "boats," which was charged when purchased, to operating expenses. To that extent the figure is changed.

7. Crystal Springs Upper Dam.

The items appearing under this head in the major group schedule,—

Hazen	Dockweiler	Dillman
$261,300.	$184,283.	$171,143.

were discussed herein under group 2a, Earth Dams.

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Table 47.

COMPARISON REPRODUCTION COST ESTIMATES UPON SUNOL FILTER BEDS
Excluding Overhead and Interest-during-Construction
As of December 31, 1913.

Pg.	Structure No.	Name of Structure	Hazen	Dockweiler	Dillman
		Sunol Filter Beds			
68	1	Concrete Gallery above Water Temple	$76,255	$49,105	$45,623
	2	Sunol Water Temple (Forebay "A")	13,112	4,637	13,047
	3	Sunol Water Temple (Superstructure)	17,845	21,447	7,000
69	4	Concrete Filter Gallery Forebay "A" to Forebay "B"	14,164	7,791	9,415
69	5	Forebay B	1,855	1,277	1,394
	6	Concrete Filter Gallery, branch from Forebay "B"	6,700	3,727	4,657
	7	Concrete Filter Gallery, Forebay "B" to double Manhole	19,544	10,671	13,120
	8	Concrete Double Manhole	570	361	417
	9	Concrete Filter Gallery Double Manhole to Forebay "C"	11,730	6,417	7,888
	10	Forebay "C"	1,897	1,166	1,346
	11	Concrete Filter Gallery, Forebay "C" to Forebay "D"	54,678	29,937	37,552
70	12	Forebay "D"	2,722	2,120	2,074
70	14	Concrete Filter Galleries, Forebay "A" to Forebay "D"	2,141	1,366	2,509
70	15	Galleries and Forebay below Water Temple	125,685	94,526	50,686
70	16	Gravel Dam near Forebay "B"	902	838	876
71	17	Gravel Dam at end of branch gallery	279	248	134
71	18	Gravel Dam near Forebay "C"	1,933	1,547	1,898
71	19	Sunol Dam	25,297	18,673	20,851
71	20	Timbered Filter Gallery	8,561	6,726	6,767
72	21	Hadsell Ditch	5,802	4,127	5,907
72	22	Suspension Footbridge, Sunol Dam	600	460	389
72	23	Suspension Footbridge near Water Temple	800	633	533
		Total	$393,072	$267,800	$234,083

Table 48

COMPARISON REPRODUCTION COST ESTIMATES UPON
Itemized Structures—Sunol Filter Beds
Excluding Overhead and Interest-during-Construction Allowances
As of December 31, 1913

Pg.	Structure No.	Name of Structure	Quantity	Hazen		Dockweiler		Dillman	
				Unit	Amount	Unit	Amount	Unit	Amount
		SUNOL FILTER BEDS							
68	1	Concrete Gallery above Water Temple							
		Excavation, Plow and Scraper, Top Soil and Gravel	67,299 cu. yds.	$0.30	$20,190	$0.18	$12,114	$0.25	$14,825
		Excavation, Pick and Shovel (Gravel)	10,721 "	2.00	21,442	1.40	15,009	.50	5,360
		Concrete in Place, Gallery	2,188.9 "	10.00	21,889	7.00	15,322	8.00	17,672*
		⅝" Rods Steel Reinforcement	124,196 lbs.	.04	4,968	.03	3,726	.04	5,661
			17,320 "	.04	693	.035	679		
		Miscellaneous			7,073		2,255		2,104
		Total			$76,255		$49,105		$45,623
	2	Sunol Water Temple Forebay "A"							
		Excavation, Pick and Shovel (Gravel)	558 cu. yds.	$3.00	$1,674	$1.60	$ 893		
		Concrete, Plain	438 "	10.00	4,380	6.50	2,847	$8.00	$ 3,504
		Concrete, Reinforced	318 6 "	15.00	4,779			10.00	3,186
		Miscellaneous			2,279		897		6,357
		Total			$13,112		$ 4,637		$13,047
	3	Sunol Water Temple (superstructure)	Complete		17,845		21,447		7,000
69	4	Concrete Filter Gallery Forebay "A" to Forebay "B," Concrete	1,149.4 cu. yds.	$12.00	13,793	$6.50	7,471	$8.00	9,192
		Miscellaneous			371		320		223
		Total			$14,164		$ 7,791		$ 9,415
	5	Forebay "B," Concrete	113.3 cu. yds.	$12.00	1,360	$6.50	736		1,394
		Miscellaneous			495		541		
		Total			$ 1,855		$ 1,277		$ 1,394
	6	Concrete Filter Gallery Branch from Forebay "B" Concrete	520.8 cu. yds.	$12.00	6,250	$6.50	3,385	$8.00	4,166
		Miscellaneous			450		342		491
		Total			$ 6,700		$ 3,727		$ 4,657
		*Dillman has 2,209 cu. yds. concrete.							
69	7	Concrete Filter Gallery, Forebay "B" to Double Manhole, Concrete	1,605.8 cu. yds.	$12.00	19,270	$6.50	10,438	$8.00	12,846
		Miscellaneous			274		233		274
		Total			$19,544		$10,671		$13,120
	8	Concrete Double Manhole	Complete		570		361		417
	9	Concrete Filter Gallery Double Manhole to Forebay "C," Concrete	960.4 cu. yds.	$12 00	$11,525	$6.50	$ 6,243	$8.00	$ 7,683
		Miscellaneous			205		174		205
		Total			$11,730		$ 6,417		$ 7,888
	10	Forebay "C," Concrete	134 cu. yds.	$12.00	1,608	$6.50	871	$8.00	1,072
		Miscellaneous			289		295		274
		Total			$ 1,897		$ 1,166		$1,346
	11	Concrete Filter Gallery Forebay "C" to Forebay "D," Concrete	4,425.6 cu. yds.	$12 00	53,107	$6.50	28,766	$8.00	35,405
		Miscellaneous			1,571		1,171		2,147
		Total			$54,678		$29,937		$37,552
70	12	Forebay "D," Concrete	119.7 cu. yds.	$12 00	1,436	$6.50	778		2,074
		Standard Sluice Gates 3.5' x 3.5' with operating mechanism	3 each	4.00	1,200	4.10	1,230		
		Miscellaneous			86		112		
		Total			$ 2,722		$ 2,120		$ 2,074
	14	Concrete Filter Galleries, Forebay "A" to Forebay "D," 550 pcs 60 # steel rail 4.5' long	49,500 #	$0.03	1,485	$0.017	841		2,509
		170-6" I Beams 6.3' long	13,119 #	.05	656	.04	525		
		Total			$ 2,141		$ 1,366		$ 2,509
	15	Galleries and Forebay below Water Temple							
		Excavation, plow and scraper (top soil and gravel)	98,232 cu. yds.	$0.30	29,470	$0 1$	17,682	$0 25	24,558
		Excavation, pick and shovel (gravel)	15,551 "	2.00	31,102	1.60	24,882 34,415		
		Excavation, pick and shovel (earth)	98 "	2 00	196	1.60	157 cu. yds.		
		Excavation, pick and shovel (blue clay)	8,641 "	2 50	21,603	1.60	13,826 @$0.50		17,208
		Excavation, pick and shovel (yellow clay and gravel)	5,208 "	2 50	13,020	1.60	8,333		
		Excavation, pick and shovel (slate)	4,917 "	2 50	12,293	2.00	9,834		
		Ordinary backfill	44,693 "	.20	8,939	.20	8,939	.15	6,705
		Hand placed backfill	8,450 "	1.00	8,450	1.20	10,140 8,858		
		Hand placed backfill, selected gravel	408 "	1.50	612	1.80	734 c. y. @	.25	2,215
		Total			$125,685		$94,526		$50,686
70	16	Gravel Dam near Forebay "B"	Complete		902		838		876
	17	Gravel Dam at end of Branch Gallery	Complete		279		248		134
	18	Gravel Dam near Forebay "C," 30" Riveted W. 1. Pipe	230 lin. ft.	$3 00	$ 690	$2.15	$ 494		1,898
		Excavatiou for pipe	1,252 cu. yds.	.70	876	.40	501		
		Miscellaneous			367		551		
		Total			$ 1,933		$ 1,547		$ 1,898
71	19	Sunol Dam Concrete Structure							
		Excavation Gravel	1,977 cu. yds.	$2.00	3,954	$1.60	3,163		
		Excavation, rock	434 "	3.00	1,302	2 40	1,042		
		Concrete	1,966.2 "	9.00	17,696	6.50	12,780	8 00	15,730
		Rubble masonry	97 "	9.00	873	5.25	509		
		Raft R. O. P.	22.176 M.B.M.	33.00	732	25.75	571		
		Miscellaneous			740		608		5,121
		Total			$25,297		$18,673		$20,851
	20	Timbered Filter Gallery	Complete		8,561		6,726		6,767
71	21	Hadsell Ditch							
72		Excavation, plow and scraper, top soil and gravel, main ditch	13,774 cu. yds.	$0 20	2,755	$0.16	2,204		5,907
		Gulvert 5' x 6' concrete	192.7 "	12 00	2,312	7.00	1,349		
		Miscellaneous			735		574		
		Total			$ 5,802		$ 4,127		$ 5,907
72	22	Suspension Foot Bridge, Sunol Dam	Complete		600		460		389
72	23	Suspension Foot Bridge, near Water Temple	Complete		800		633		533

8. Sunol Filter Beds.

The major group schedule on Sunol filter beds shows the following items, excluding the reproduction cost of the buildings, which were covered in the joint exhibit:

Hazen	Dockweiler	Dillman
$393,072.	$267,800.	$234,083.

These items have been further segregated in the following summaries: the first, showing the major group; the second, the more important figures influencing the variation in the estimates of the several engineers. I now present tables 47 and 48.

[Tables inserted opposite]

A brief study of these figures will recall to your Honor's memory the fact that the chief differences in estimates are to be found in the items of excavation and of concrete, both of which have been thoroughly covered in the discussion upon earth and concrete dams and flumes, and it is therefore unnecessary to retrace this ground. We, therefore, content ourselves with merely calling to your attention the fact, which appeared in the evidence, that neither Dockweiler nor Dillman made sufficient allowance for the water which would have to be taken care of, either by first lowering the general ground water table, or level, to a point below the structure, or by handling the water which would inevitably flow into the work during the building of the structure.

Hazen referred especially to the cost of this pumping and showed photographs indicating the wet character of the work and cited the actual experiences of those who had been connected with it during construction.

Your attention is further called to the fact that where small quantities of either excavation or concrete are involved it is not possible, as Hazen stated at various points in his discussion of costs, to realize such small unit figures as where a very large amount of work is to be handled at the same time.

It needs no argument to make this clear, for either the higher costs of the hand work incidental to the rehandling of the excavated earth, or mixing and placing of the concrete masonry, or high cost of plant, in view of the small amount of material to be handled, as compared with the cost of getting the machinery on the ground and in operating condition, is to be incurred.

We submit that, in the light of the past discussion of these unit costs, Hazen's figures are fair, and that the figures of Dockweiler and Dillman are clearly inadequate.

9. Sunol Filter Bed Buildings.

These are really not buildings but appurtenant structures. The major group schedule shows the following figures,—

Hazen	Dockweiler	Dillman
$5,423.	$5,758.	$150.

It is to be noted, however, that these figures are exclusive of the buildings in the joint exhibit.

Hazen's and Dockweiler's figures are all in substantial agreement; those of Dillman clearly did not cover all of these items.

10. Niles Aqueduct.

The major group schedule shows the estimates of Hazen and Dillman upon the Niles aqueduct to be in absolute accord; Dockweiler's figures were somewhat less. We submit that the former should prevail.

Hazen	Dockweiler	Dillman
$93,603.	$78,585.	$93,566

all exclusive of buildings included in the joint exhibit.

11. Submarine Pipes.

The estimates of the several engineers upon the submarine pipes listed in the summarized major group comparison are as follows:

Table 49.

	Hazen	Dockweiler	Dillman
Totals (before revision)	$450,695	$321,582	$305,674

These amounts comprise the estimates upon the following structures:

Inventory Pg.	Inventory Str.	Name	Hazen	Dockweiler	Dillman	Dorward*
133	19	Fittings, Newark slough	$8,017	$11,083	$6,930	.....
134	20	Fittings, Dumbarton	7,861	11,437	6,500	.....
135	21	Fittings, west side Newark	3,219	5,272	2,700	.....
137	33	Fittings, Ravenswood	4,598	7,680	4,700	.....
		Sub-total	$23,695	$35,472	$20,830	.....
135	22	Submarine pipes	427,000	286,110	284,844	$297,376*
		Total comparable with Major Group Schedule	$450,695	$321,582	$305,674	.....

*Dorward, defendants' witness submitted evidence upon the laying of the pipes only and did not include the other structures enumerated.

Here again note Hazen's procedure. Not content with the scheduled weights and quantities shown in the inventory and recorded drawings of the submerged pipes, he inspected the unused pipes in the Millbrae yard; measured the pipe itself, found it did not conform to the schedule,—that the original drawings had to be modified to allow for clearance in making the joints; re-figured the recorded weights of pipe and lead; walked over, inspected, and photographed the exposed portions of the pipe itself at low tide to get as clear an idea as possible of its present condition,—instead of looking at it from the bridge, 800 to 1,000 feet away, as Dillman did; made diligent search of available construction and cost records; conferred with Hermann Schussler, Lawrence, Sharon and others about the actual construction and source of the materials used; noted the unusual features of the flexible joints,—the castings shrunk on and riveted to the welded steep pipes, giving them greater strength and ability to resist disturbance by tide or earthquake; observed that the cost of the materials would perhaps be approximately the same today as in 1901-2, when the two lines of 22-inch pipe were built, but that the labor cost would be greater at the present time. He found that the pipes have been tight, that there has been no repair to them whatever since they were laid, and that they are believed to be perfectly tight at the present time, and observed that this is almost an unequaled record. He visited Portland, Oregon, and Vancouver, B. C., to make inspection of and inquiry upon the cost of submerged pipe crossings built there, and read the published accounts of the former. He reviewed the cost of laying two lines of 30-inch steel pipe under the Connecticut River at Springfield, Mass., and a 24-inch line at Superior, Wis., both built under his design and direction. Finally, he fixed the fair cost of the 22-inch pipe lines at $259,200, approximately 9% above actual cost, which he found to be $240,000 as of the year 1901-2, and the cost of the two lines of 16-inch pipe at $164,300, making a total cost for the submerged pipe lines of

$423,500, all as set forth in Plaintiff's Exhibit 96, p. 135; Plaintiff's Ex. 98n, o, p, q; Tr. 4760-72, Ab. 1272-1277.

This was no snap judgment or educated guess, but the deliberate judgment of a very able and experienced engineer, who had thoroughly investigated and discriminatingly weighed the nature of his problem, the local conditions, and the available facts and record of this and other comparable work, in the light of his own past experience and information upon construction of this particular character.

Dockweiler made diligent search of the company's records of construction, but neglected to make detailed examination of the structure itself. He based his estimate upon the inventoried quantities (4773, 4858, 4880).

Without personal experience in such work, he first obtained quotation upon the material, by letter, of a most general character, addressed to Crane & Company, likely to draw forth figures substantially lower than would have been given on bona fide bid upon carefully prepared specifications, as was recognized by Dorward in his testimony upon figures so obtained (4926-7).

Next, with the aid of offhand quotations from Healy & Tibbitts, general contractors of San Francisco, upon the cost of an unloading barge which he says would be fully equipped, and rental rates upon certain machinery, and with the further aid of the fragmentary construction records of the company which showed the rate of progress but not the number of men employed, he assumed that two barges would be required (though Dorward (5976) stated that three barges were actually used), and made estimate of the number of men which he thought might be employed, neglecting all consideration of contingencies on his theory that now that the work had been built the contingencies had been passed,—thus eliminating the element of hazard which the contractor and the company faced and for which the company actually paid. The impropriety of such exclusion suggests itself on a reading of Dockweiler's testimony (4785-4790) upon this particular subject.

It is in this estimate of the labor cost of the work that the company suffers most in Dockweiler's estimation,—the difference in this item for the 16-inch pipe, between Hazen's experienced estimate and Dockweiler's guess, being indicated by their respective figures of $120,000 and $52,500.

Dockweiler cited no comparative figures, and, as stated, had had no personal experience in such work. His final estimate of the fair cost of the 22-inch pipe lines amounted to $191,507, which he subsequently corrected, as to the allowance for lead, giving a total of $194,706, comparable with the original cost of $240,000, and Hazen's estimate of $259,200; and upon the 16-inch pipes $94,604, to which he subsequently added an allowance for lead of 15.5c per foot upon 13,563 feet of pipe, $2,100, amounting to $96,704, comparable with Hazen's estimate of $164,300, and making the total allowance for all of the submerged pipe lines of $291,410, comparable with Hazen's figure of $423,500.

Dorward looked up his old records and gave for the defendant his estimate of the cost of reproducing the submerged pipe lines. His records were of a personal nature and were not based upon the actual records of the office. He had and used the record of the pipe transported to the pipe-laying barges, though he had no record and did not know how much pipe was actually purchased. He used 5.6c per pound for the metal delivered, taking this from Dockweiler, which figure was an offhand manufacturers' quotation and not the result of a bona fide bid on carefully prepared specification. He added no percentage to this, for the reason, as he said, that the pipe was furnished to the Risdon Iron Works by the Spring Valley Water Company, although it was the custom of the shop to add 10% to material bought by them, and though he does not know if profit was in fact figured by the Risdon Iron Works upon this material, as well as upon the labor (5993), and although he admits that the earning of a proper profit on the labor

alone is more difficult than when the profit may be spread over the cost of the materials as well as labor.

His estimate of the weights of the bells and nipples was substantially less than that of Hazen and Dockweiler upon the 16-inch pipe (430 pounds per joint, as against 525 and 508 pounds, respectively) and substantially more in the case of the 22-inch (1455 pounds per joint, as against 1364 and 1346 pounds per joint).

His figures amounted to $95,810 upon the 16-inch pipe, and $201,566 upon the 22-inch, the original cost of which he admits amounted to at least $225,462,—based upon an assumed cost of 5.6c per pound for the metal, which was the reproduction cost figure given to him by Dockweiler, as he had no record of the actual cost of this pipe. If Hazen's figures upon the cost of the pipe should be substituted for Dockweiler's, the original cost of Dorward and Hazen would be substantially identical. Hazen, it will be remembered, reported the cost of the 22-inch pipe, including some items paid for by the company of which Dorward could have had no knowledge, to have been $240,000.

Dorward's total for all of the submerged pipe lines was $297,376, based upon his revised and reduced profit allowance.

It will thus be seen that the actual cost of the 22-inch pipe line was approximately 20% in excess of Dorward's figures. The actual cost of the 16-inch line, on the basis of the actual cost of the 22-inch pipe line, exceeded Dorward's figures by a substantially greater percentage.

Dillman looked at the submerged pipe line from (4854) the bridge 1000 feet distant, and then based his estimate upon the inventoried quantities, applying the round figures of $7.50 per foot upon the 16-inch pipe and $13.50 upon the 22-inch, arriving at his final estimates of $101,730 and $183,114, totaling $284,844, comparable with Hazen's figure of $423,500 (4825-26; 4850; 4858).

Under cross-examination Dillman stated that he did not attempt to make any segregation of items entering into the cost of laying

the submerged pipe lines, that he had only some (4854) impressions upon the cost of the first Bull Run pipe crossing of the Portland, Oregon, water works under the Willamette River (4850), and admitted that he was virtually without personal experience in such work.

"MR. GREENE: Q. Mr. Dillman, did you ever lay any submerged pipe yourself?

"MR. DILLMAN: A. No sir, not with a ball joint, nothing of this kind.

"Q. Did you ever see any laid?

"A. I saw a little of the work done on the first Bull Run pipe crossing the Willamette River at Portland."

* * * * * * * *

"Q. Do you know anything about the costs that were incurred in the laying of it, aside from what you heard stated this morning?"

* * * * * * * *

"A. No sir, I have not anything definite, only the impression I retain from that time.

"Q. What is the basis of your estimate, then, Mr. Dillman?

"A. The reason for this price is primarily the belief that I could induce a contractor who would finish the job, a reliable contractor, to take the job at these prices. It is also comparable with the last price of the Willamette crossing at Portland, but the exact connection I haven't.

"Q. The exact connection you haven't?

"A. No; that is, I don't know now the cost of that pipe.

"Q. Then you could not have used that in forming your opinion as to the reproduction cost of this pipe, could you? A. I think I did to a certain extent and to a greater extent probably than anything else.

(4856) "MR. GREENE: Q. I still do not appreciate where you derived, if I may term it, your diameter formula. Is that from a mass of your data which has been destroyed?

"MR. DILLMAN: A. I have no data. All I have in the matter of submerged pipe and in the matter of a great deal of other work are impressions gained from the experience that I have had. I have not had very much experience in the matter of submerged pipe.

"Q. You have not had any, have you?

"A. I have not laid any. No, not with the actual laying of pipes.

"Q. So we can leave that out of consideration? Now, what is it you are banking on?"

* * * * * * * *

"A. I stated I knew approximately the cost of the second Bull Run pipe line, and I think that was the basis of this estimate."

* * * * * * * *

(4857) "Q. Then it is a fair statement that the only information which you had which led to the figures which you employed were the figures on the second Bull Run line at Portland? A. That was the most nearly applicable information I had.

"Q. I would like an absolute answer to that, Mr. Dillman; that is the fact, is it not, there were not any other figures? A. Oh, yes, there were other figures I had read from time to time and believed.

"Q. But you did not use those, did you? A. I don't know to what extent they were used.

"Q. Did you use them at all? Do you wish to be understood that you did?

"A. I cannot tell to what extent they entered.

"Q. What other figures were there? I don't mean the exact figures, I mean on what pipes?

"A. Just the various descriptions I have read in the technical papers—that is all.

"Q. Do you remember what lines they were? A. No, I don't remember that I do."

(4942) Upon being shown a copy of the Transactions of the American Society of Civil Engineers (Vol. 40, No. 9, November, 1914) containing the report of Chief Engineer D. D. Clark on the 24-inch line of the second Bull Run submerged pipe and being asked by Mr. Greene to "state what the cost per foot on that pipe was on those figures," counsel for the defendants promptly objected.

"MR. SEARLS: It would be perfectly proper for you to introduce that as your own testimony, if you want to; Mr. Dillman has not said that he relied on this article for his information.

"MR. GREENE: He said that the cost of the Portland job was the only cost which he had when he made this; I think the inference is fair from the testimony that that was the basis of his appraisal.

"THE MASTER: That is what I understood. Of course, it is a mere matter of making a calculation, Mr. Greene, and you cannot ask Mr. Dillman to do it unless he wants to."

Upon request of his counsel, Mr. Dillman was given time to read the article.

After looking up D. D. Clark's article, in the Transactions of the American Society of Civil Engineers, upon the submerged pipe lines laid in Portland under the Willamette River, Dillman concluded that he had been wrong in his first impression that it was the cost record of the first Bull Run pipe line, and in his second impression that it had been the second and not the first Bull Run pipe line, and that the records discussed by him (4998) with Clark were really those relating to the 30-inch pipe line laid in 1910.

Taking his final statement, therefore, Dillman based his estimate upon some knowledge of the cost to the City of Portland, Ore., of laying its 30-inch submerged pipe under the Willamette

River in 1910, and stated that he had the figures on the cost of the 22-inch pipe line laid by the Spring Valley Water Company but did not use them, and that he (4999) had some general impressions from his reading, but no further specific information.

It appeared later, however, that he did not apply the Portland figures directly, but first reduced the actual cost of this line as stated by him from $33.48 to $27 per foot by eliminating certain actual dredging costs and then applying the arbitrary ratio of the squares of the pipe diameters to this 30-inch pipe to determine his unit costs for the 16- and 22-inch pipe,—thus arbitrarily arriving at the figures $7.68 and $14.52, from which came his assumption of $7.50 and $13.50. It is to be noted further that Hazen's interpretation of Clark's article, in the Transactions of the American Society of Civil Engineers, upon which Dillman's estimate was based, gave a cost of $45 per linear foot for the 30-inch pipe instead of $27 assumed by Dillman.

Dillman's attention was further called to the fact that if the costs of the Portland 24-inch pipe line were applied to the 16- and 22-inch pipe lines, on his arbitrarily assumed basis of the ratio of the squares of the diameters, the resulting figures would be respectively $9.30 and $17.70 per linear foot, as compared with his assumed amounts of $7.50 and $13.50 per linear foot. Moreover, Dillman admitted that the conditions as to exposure and winds under which the pipe lines were laid from Dumbarton to Ravenswood are much more trying than at Portland.

As bearing upon the hazard element involved in the laying of submerged pipes as pointed out by Hazen (4832, 6018) we call your Honor's attention to the contract recently let to Robert C. Storie & Company by the City and County of San Francisco for the furnishing and laying of an 18-inch (an intermediate size to those involved here) cast-iron submerged pipe for the sum of $18 per lineal foot (11,160-1). It is to be noted that the Baker's Beach pipe is cast-iron, and is therefore of less expensive material

than that (steel tubing) employed in the company's submerged pipe lines.

I now present Table 50.

[Table inserted opposite]

A review of this table shows the reproduction cost estimates of the various engineers for the two lines of pipe and the points in the estimate in which they differ. The differences in the estimate are due, first, to the assumed weight of the straight pipe; second, to the assumed price of the galvanized metal delivered in San Francisco; third, to the assumed weight of the bells and nipples; fourth, to the assumed cost per foot of bells and nipples shrunk and riveted on to the pipe; fifth, to the assumed cost of lead as to which the difference is negligible; sixth, to the assumed cost of laying, wherein substantially the entire difference in estimates lies.

It will thus be seen that the major difference in estimates lies wholly in the estimated cost per foot of laying the pipe, Hazen's figures being in excess of Dockweiler's and Dorward's by $132,090 and $126,124, respectively.

As to this pipe laying cost, Dockweiler and Dillman admit having had no personal experience and practically no comparative figures—except the original costs of one of the pipe lines in Dockweiler's case, and the cost of the 30-inch Portland pipe line in Dillman's case. Dorward possessed and used no figures except his original cost figures for the 22-inch pipe lines, and it is to be remembered that these figures were not the office figures of the Risdon Iron Works, but his own figures, made without specific knowledge as to the actual overhead costs or as to the actual payment to the Risdon Iron Works by the Spring Valley Water Company. His estimate of present value was $40,000 less than actual cost. Dorward did not have the office records of actual cost aside from his own department. He further figured on his own personal experience and eliminated any allowance for hazard.

Hazen's figures, on the other hand, were based upon a knowl-

Table 50.

Comparative Analysis:

We have then the following comparative estimates upon the cost of reproducing the submerged pipe lines, as inventoried in Pl. Exh. 97, page 135, Structure 22.

	Hazen	Dockweiler	Dorward	Dillman
22″ Original cost	$240,000	.....	$225,462	*.....
22″ Reproduction cost	$259,200	$194,706	$201,566	$183,114
16″ Reproduction cost	164,300	96,704	95,810	101,730
Total reproduction cost	$423,500	$291,410	$297,376	$284,844
Amount less than Hazen	.....	$132,090	$126,124	$138,656

*Including metal at Dockweiler's price 5.6c but substantially identical with Hazen's figures based upon Hazen's cost of metal.

The differences in the estimates are due—

First, to the assumed weight of the straight galvanized pipe,

					Total
Hazen	16″	712,000 lbs.	22″	1,270,000 lbs.	1,982,000 lbs.
Dockweiler	=	710,118 "	=	1,177,882 "	1,888,000 "
Dorward		722,115 "		1,189,843 "	1,911,958 "

Second, to the assumed price of the galvanized metal delivered in San Francisco,

					Total	Corrections to Hazen's Wt.
Hazen	16″	$42,100	22″	$75,000	$117,100	
Dockweiler	=	39,767	=	70,673	110,440	$116,000
Dorward		40,365		71,285	111,650	116,000

Third, to the assumed weight of the bells and nipples,

Hazen	16″	525 lbs.	22″	1,364 lbs.
Dockweiler	=	508 "	=	1,346 "
Dorward		430 "		1,455 "

Fourth, to the assumed cost per foot of bells and nipples shrunk and riveted on to the pipe,

					Total
Hazen	16″	$2.25	22″	$5.80	$109,500
Dockweiler	=	2.62	=	6.93	129,780x
Dorward		2.33		7.05	126,656x

xIncludes an allowance of 25% for profit.

Fifth, to the assumed cost of lead as to which the difference is negligible,

Hazen	Both Pipes	$15,200
Dockweiler		18,552x
Dorward		15,726x

xIncludes an allowance of 25% for profit.

Sixth, to the assumed cost of laying, **wherein substantially the entire difference in estimate lies.**

					Total	Amount less than Hazen's Est.
Hazen	16″ at $6.25=	$85,000	22″ at $6.75=	$91,500	$176,500	
Dockweiler	=	13,412	=	13,412	26,824	$150,000
Dorward		17,477		21,466	38,943	137,600

	Total amounts accounted for above	Total amount of estimate	Difference*
Hazen	$418,300	$423,500	$5,200
Dockweiler	285,596	291,410	5,814
Dorward	292,975	297,376xx	4,401
Dillman	.....	284,844	.....

*Chiefly due to omission of coating item.

xxDorward's total for 16″ and 22″ pipes shown in Def. Exh. 119.

The total obtained by applying Dorward's units is $298,105. The difference is due, largely to an error ($1.82 per foot vs $1.77 per foot) in his computation of saving upon 1907-13 price over the 1901-02 (Dorward's assumed cost) price on the 22″ pipes.

edge of the original cost figures on the 22-inch pipe line, the cost of the Portland, Vancouver, Springfield and Superior pipe lines, as well as other comparable work.

Finally, Metcalf gave testimony concerning the following records of submerged pipe crossings which had been laid under his direction and with which he was personally familiar, which it will be seen corroborated Hazen's assumed cost of laying the 16- and 22-inch pipes, $6.25 and $6.75 per foot, respectively, in a (4770-4842) striking manner.

I now present Table 51:

Table 51.

		Contract cost per foot for laying only		Estimate cost to contractor excluding profit	
Concord River	8 in. 155 ft.	$5.00	Aver. $6.68	$6.58	Aver. **$5.78**
Concord River	8 in. 125 ft.	5.00		7.15	and including
Concord River	12 in. 141 ft.	4.20		3.65	Dorward's
Sebasticook River	10 in. 260 ft.	12.50		5.76	25% profit= **$7.23**
Kennebec River	20 in. 800 ft.	$6.50	Aver. $6.84	$4.12	Aver. **$8.18**
Messalonskee River	20 in. 318 ft.	6.50		4.77	and including
Shoddy Hollow Slough	24 in. 254 ft.	6.99		7.54	Dorward's
Bayou	12 in. 124 ft.	7.40		6.67	25% profit=
Davis Mill Pond	24 in. 270 ft.	6.81		17.80	**$10.22**
China Lake Intake	24 in. 558 ft.	$15.80		$32.00	
New Bedford Sewer in Buzzards Bay, 60 in.		14.00			

It is to be noted that in the sub-joined figures relating to the Concord work, deduction has been made for the cost of the pipe itself, upon the basis stated by the witness, $25 per ton, with an assumed pipe weight of 40 pounds per foot for the 8-inch pipe, making the total allowance therefore $1.00 per foot; and 72 pounds per foot for the 12-inch, or $1.80 per foot, in order that the cost of laying only (exclusive of the pipe itself) might be compared.

As I have said, this work done under the personal supervision and direction of Mr. Metcalf serves as a strict corroboration of

Hazen's estimates for similar work. Note further what Metcalf has to say (4845):

"In all of these first figures which I have given, the work was done without a dam, in some of the shallow cases simply using a sand-bag dam and a trough to carry the stream over in the narrower crossings; in the river crossings of which I have spoken, they were shallow work, and of course in none of them was a dredge used, nor did the work involve the submarine apparatus to the extent that was used in this case. In other words, I believe these figures to be on work of a character very much less exacting and less expensive."

We submit that the fairness of Hazen's figures upon the reproduction cost of the submerged pipe lines was proven, and that this example, typical of many of the estimates of defendants' witnesses, indicates the grave danger of underestimating the cost of labor and the hazard involved in actual construction work.

The estimates upon the fittings and shore connections of the submarine pipes amount, upon the estimates made by Hazen, Dockweiler and Dillman, to $23,695, $35,472 and $20,830, respectively.

Hazen's figure for these remaining items is but slightly above Dillman's and materially below Dockweiler's. We are content, however, to stand upon it.

A reduction was made by Hazen from his estimate upon the submarine pipes ($427,000) of $3,500, to cover his agreement with Dockweiler on the cost of the lead in the joints. Hazen's corrected figure upon the submarine pipes, therefore, becomes $423,500, and Dockweiler's, $291,409; (the latter increased from $286,110.) The Major Group Schedule item upon submarine pipes, when revised to cover these corrections, therefore, becomes:

Hazen:	Dockweiler:	Dillman:
Total after revision:		
$447,195.	$326,881.	$305,674.

12. Roads, Fences, Electric Transmission Lines and Ravenswood Wells.

The Major Group Schedule shows the following comparative estimates:

Hazen	Dockweiler	Dillman	Joint Exhibit
$307,674	$333,636	$252,221	$276,000

Pleasanton Ranch Fences $11,500

These ranch house fences were separately listed in Joint Exhibit 137.

13. Lake Merced Drainage System.

The Major Group Schedule shows the following amounts, excluding tunnels, (I now present Table 52):

Table 52.

Hazen	Dockweiler	Dillman
$214,834	$148,956	$173,770

(the figure in Dillman's exhibit $173,757, showing error of $13 in his footing).

These amounts may be further segregated into the following items:

Item	Hazen	Dockweiler	Dillman
1. Wrought Iron Pipe.....	$30,467	$15,054	$23,716
2. Concrete.....	9,763	6,056	6,382
3. Brickwork.....	68,911	44,720	49,496
4. Earthwork.....	40,330	25,254	26,941
5. Flumes.....	13,841	14,776	12,396
6. Miscellaneous.....	51,522	43,096	54,826
Totals.....	$214,834	$148,956	$173,757

The difference in these estimates is covered in three different classes of units,—first, concrete, which Hazen estimates for the small amount involved at $12 per cubic yard, and Dockweiler $7.50 per cubic yard (though he uses $8 for a small portion of

the concrete); second, brickwork, upon which Hazen allows $30 per thousand; Dockweiler $24.50, and while Dillman does not segregate his figures, he stated in his testimony that upon his brickwork he used from $20 to $25 per thousand of brick; third, earth work, embodying filling, ditch excavation and flume benching.

For the earth fill Hazen allows 50c per cubic yard; Dockweiler 15c and 18c; Dillman gives no units; upon the earth ditch excavation Hazen 30c and 35c per cubic yard; Dockweiler 19c and 28c; Dillman no figures; upon the rock excavation Hazen $1; Dockweiler 50c; Dillman no details; upon the flume earth excavation Hazen 40c; Dockweiler 30c; Dillman no figures.

We have already discussed each of these subjects. Hazen's concrete figures are predicated upon higher cost for cement and larger unit prices for placing the same, particularly in small quantities. The brickwork has been discussed heretofore, not only in connection with the tunnel linings, but in a more comparable case,—the brickwork incident to the building of the Crystal Springs dam reservoir linings, and other miscellaneous brickwork.

THE MASTER: In this Table 52, one of the principal differences is in wrought iron pipe; is that covered by a joint exhibit?

MR. GREENE: That will be covered by the discussion on reproduction cost. There is no difference in principle in the wrought iron pipe when it is considered here and when it was considered in the first instance.

THE MASTER: It is not included in the city distribution system.

MR. GREENE: No, it is not, your Honor.

THE MASTER: That was a matter upon which you agreed, was it not?

MR. GREENE: We agreed on a portion of riveted pipe, but as to a small portion of it we did not. I am also coming to that.

MR. SEARLS: This is not included either in item No. 1 on your Major Group Schedule.

MR. GREENE: No, it is not; this is an entirely independent item, which is not considered in any of the groups.

The earth work was fully discussed in connection with dams and flumes. What we said therein finds application here also.

We submit, therefore, that upon the Lake Merced structures Hazen's figures alone are accurate, and that he submitted such comparative figures upon concrete and brickwork figures as to warrant their adoption.

14. Lake Merced Supply and Discharge Pipes to Pumps.

The Major Group Schedule shows the following amounts, and I now present Table 53. Your Honor will observe here that there is riveted and cast-iron pipe also not covered under any other item.

Table 53.

Hazen	Dockweiler	Dillman
$103,093	$96,607	$89,596

These items may be further segregated into the following:

Item	Hazen	Dockweiler	Dillman
1. Riveted and Cast Iron Pipe..	$97,374	$84,313	$74,380
2. Trestles.....	1,247	1,329	1,524
3. Wharves.....	4,472	4,381	5,452
	$103,093	$90,023	$81,356
At Structure 6 which we eliminate to make figures comparable with Hazen's.....	.....	6,584	8,220
	$103,093	$96,607	*$89,576

*Note, that Dillman made error in his footings of $10.

It is evident that the chief difference in the schedule lies in the estimates covering the riveted and cast-iron pipe work. As Hazen's figures were so thoroughly substantiated upon these subjects, we submit that his estimate of this group of items should be accepted.

MR. SEARLS: It occurs to me that there was no testimony on the cast-iron pipe.

MR. GREENE: Yes, I think Mr. Hazen did testify as to cast-iron in a general way; I think you will find that in his discussion.

MR. SEARLS: I thought we covered all the cast-iron in the system in our stipulation.

MR. GREENE: All the cast-iron except this one item, and the difference there is not very large.

15. 30-Inch Conduit from Ocean View to Central Pumps.

The Major Group Schedule shows the following figures:

Hazen	Dockweiler	Dillman
$21,000	$28,745	Not valued

We are content to stand upon Hazen's figures.

THE MASTER: Did Dillman overlook it?

MR. GREENE: Apparently. I was just going to say that he failed to value it, we assume, because it was included in the addenda to the volume, and not in the inventory itself.

16. Lake Honda Supply Main.

I present this table, No. 54.

Table 54.

Item	Hazen	Dockweiler	Dillman
1. Original Pilarcitos Pipe.....	$54,209	$42,978	$43,919
2. New 30″ Wrought Iron Pipe.	28,000	16,588	23,744
3. 22″ Connection between Lake Merced Force Main and New 30″.....	1,312	1,332	1,202
4. Ocean House Flume.....	14,791	12,947	10,738
5. 3″ Wrought Iron.....	1,750	1,346	2,056
6. 44″ Wrought Iron.....	9,380	5,705	8,269
Totals.....	$109,442	$80,896	$89,928

Hazen's figure is $109,442; Dockweiler's, $80,896; Dillman's, $89,928. The table shows the points of difference. It is clear that the real difference lies in the allowance for riveted pipe, as to which we believe our case has been proven.

THE MASTER: This was not discussed in the hearing at all, was it?

MR. GREENE: I think it was simply referred to. Of course, the Pilarcitos pipe is riveted pipe, the 30-inch wrought iron is riveted pipe. He has the reproduction cost here.

THE MASTER: And it is depreciated in these figures?

MR. GREENE: No, there is no depreciation account in any of these figures here with one exception, and that is Dillman's figure on the Upper Crystal Springs dam; it is depreciated originally instead of being reproduced and then depreciated on functional depreciation.

THE MASTER: Mr. Hazen did that in one of his methods.

MR. GREENE: He did that when he came to discuss depreciation, but I think he put in the reproduction cost of the structure as it was.

17. 30-Inch Central Pumps Force Main.

The Major Group Schedule shows that the estimates of the several engineers upon this structure were substantially identical, or at least they were very close. Hazen, $37,731; Dockweiler, $34,778; Dillman, $36,456.

18. City Reservoirs.

The Major Group Schedule cites the following comparison of estimates upon City Reservoirs:

Hazen	Dockweiler	Dillman
$865,817	$594,273	$652,906

The following tabulation gives the figures of the several witnesses upon each of the reservoirs and tanks grouped under the classes of excavation, embankment, puddle, masonry (including

therein lining concrete, lining brickwork, and miscellaneous masonry), miscellaneous items, and totals:

Table 55.

	Hazen's Estimate	Amount by which Hazen's figures were higher than those of	
		Dockweiler	Dillman
1. Excavation.....	$241,505	$108,704	$115,336
2. Embankment.....	23,405	13,854	15,171
3. Puddle.....	39,208	25,801	23,525
4. Masonry.....	328,761	103,535	13,214
5. Miscellaneous.....	172,481	17,356	31,514
Totals.....	$805,360	$269,250	$198,760

The estimates upon the tanks are sufficiently close to debar detailed discussion,—when Dillman's low figures upon concrete, and in lesser degree upon the miscellaneous structures, are borne in mind.

With reference to the comparative estimates upon the reservoirs, we submit the following concise tabulation showing the difference between Hazen's estimate, which was confirmed by Elliott's estimate and slightly below it, and the amounts by which Hazen's estimates were higher than Dockweiler's and Dillman's. We shall take up these items in the order in which they appear on this schedule.

THE MASTER: You spoke of tanks; where are the tanks?

MR. GREENE: The tanks are covered in this total figure of $865,817.

THE MASTER: And you have omitted them in this Table 55?

MR. GREENE: I would like to hold that table in suspense for a moment.

THE MASTER: That shows $805,360.

MR. GREENE: Yes, that is correct, $60,000 covers the tanks.

Excavation:

The amounts by which Hazen's estimate of the cost of excavation is greater than Dockweiler's and Dillman's, as segregated between the several reservoirs, is shown in the following table, No. 56:

Table 56.

Reservoir	Hazen's Estimate	Amount by which Hazen's figures are higher than	
		Dockweiler's	Dillman's
1. Lake Honda.....	$79,250	$46,324	$47,470
2. University Mound..	83,380	29,183	26,028
3. College Hill.....	19,850	7,146	9,925
4. Potrero Heights....	12,171	6,897	8,114
5. Lombard Street....	11,722	3,954	6,676
6. Francisco Street....	35,132	15,200	17,123
Total.....	$241,505	$108,704	$115,336

THE MASTER: Did Mr. Ellis give any figure on excavation here?

MR. GREENE: I think not; at least, I don't recall it. Did you, Mr. Ellis?

MR. ELLIS: No, I did not.

MR. GREENE: The principal difference in the estimated excavation cost, discussed in testimony, lies in the Honda, University Mound, and Francisco reservoirs, though some discussion was had upon that of the Cottage Hill and Potrero Heights reservoirs.

Honda Reservoir Excavation:

With reference to the Lake Honda excavation, Hazen and Elliott estimated a cost of 75c per cubic yard; Dillman and Dockweiler 30c and 31c per cubic yard, respectively. This difference was due, almost wholly, to the assumption on the part of the plaintiff's witnesses that the material actually excavated, or which

would have to be excavated in reproduction, was wet and involved either the cost of thorough drainage before excavation, or the handling of the water during excavation, which Hazen stated (7296) might well involve an additional cost of about 37½c per cubic yard. Dillman admitted (7204-16) that if the material was wet, added cost would be involved in excess of his estimate; Dockweiler (7250) referred to this as a steam shovel job, obviously impossible for such skin-work, particularly without preliminary drainage, for the cost of which he made no allowance.

As bearing upon the actual conditions and difficulties which were encountered in the making of this reservoir, Hazen referred to an article found by Sharon in the "Daily Alta" of April 3, 1865, which indicated that the material was, in fact, wet.

Elliott called attention to the fact that the amount of excavation would not completely fill the basin, which indicated that there must have been at this site a natural pond, unless there was an outlet at the north end, and that in making a recent excavation for outlet at the north end and sinking a shaft there, he found hard, solid rock which must have acted as a barrier to the outlet of the water, thus indicating that there was no natural outlet low enough to drain the basin. It was therefore established by uncontroverted evidence that the material handled was wet. We submit that the figures of plaintiff's engineers should be adopted.

University Mound Reservoir Excavation:

The substantial differences in the estimated cost of excavation at the University Mound Reservoir (Dockweiler's cost $29,183, and Dillman's $26,028, less than Hazen's costs) resulted from the assumption of the following unit figures:

By Hazen, 40c per cubic yard (embankment 25c per cubic yard) (7112); by Elliott, 40c per cubic yard (embankment 25c per cubic yard) (7172-3); by Dockweiler, 26c per cubic yard (embankment 10c per cubic yard) (7228); and by Dillman, 25c per cubic yard (embankment 15c per cubic yard) (7189).

Dockweiler justified his figures by his interpretation of the cost of excavation upon the Central Reservoir of the People's Water Company at Oakland (7245).

Dillman justified his figures on the ground of his railroad experience, which he has applied directly, except that he has allowed somewhat greater cost for compacting the material (7391-2), and in answer to Mr. McCutchen's question, "Let me ask you whether you think this excavation for the purpose of making a reservoir at University Mound is comparable to the railroad work that you have seen done for 25c or less?" says, "Yes, the same kind of material, the same haul, generally done a little less than that for railroad work, but I have added a price for compacting earth in the fill. * * * That is the only difference between this and other excavation, similar work, similar material, and the same amount of bank" (7392), and he gives some figures of railroad and ditch work which he thinks support his contention (7198-7203).

In comment upon these and similar figures, Hazen, however, says:

"I have had this sort of excavation [lateral ditch, cheap excavation, which Dillman was discussing as comparable to reservoir excavation] done myself for less than 15c, Mr. Dillman, so I know about what it figures.

"MR. DILLMAN: You have not told us about any of it here, Mr. Hazen.

(7203) "MR. HAZEN: I did not consider it comparable with any Spring Valley work."

In comment upon Dockweiler's use of the Central Reservoir figures, Hazen stated that he had gone over those figures in detail with Mr. Wilhelm, consulting engineer of the People's Water Company, after reviewing the site of the work, and talked with the latter; that the Central Reservoir excavation was easier than the University Mound (7279-80); that Dockweiler's original figures upon the Central Reservoir did not cover its entire cost (7316);

that the cost of handling the material was not the same in the two reservoirs (7317); that Dockweiler's assumed haul at the Central Reservoir of 1500 feet was excessive, which, if changed to accord with the actual average haul, stated by Metcalf to average approximately 1100 feet, according to the records (7318), would increase Dockweiler's University Mound figures (7317); that the yardage of the Central Reservoir work was less than that assumed by Dockweiler, which tended to make his figures underestimate the unit cost of the Central Reservoir work (7321). Finally Hazen called attention to the very significant fact that when the basic figures upon excavation and embankment, used by him in his reproduction cost estimate of the University Mound Reservoir, were applied to the Central Reservoir quantities, the resulting estimate would be $117,900, whereas the actual cost of the Central Reservoir as deduced by Dockweiler, increased by the item for trimming, was $124,789, or 5.8% more than the amount reached by applying the unit price used by Hazen on the University Mound Reservoir (7326). This excess, Hazen stated, was equivalent to an addition of 2c per cubic yard to his excavation figures, and not quite 4c per cubic yard for his combined excavation and embankment figures (7327). It is also important to note the fact referred to by Hazen that:

(7450) "MR. HAZEN: It seems to me that if this data has any use at all in measuring the cost of reproducing the University Mound Reservoir it has to be taken as it is in its entirety, and every element of cost that was involved in doing the Central Reservoir work must be brought into the calculation; when that is done, and when it is applied as accurately as I can apply it with Mr. Wilhelm's help explaining the conditions over there, it produces a cost which is greater than I have estimated for the University Mound Reservoir. Now to go through the (7451) record and pick out the items that are cheap, and forget the rest of them, I think that is an unfair procedure.

"MR. DOCKWEILER: I thought it was very fair because I

am using it simply to show the cost of moving material by the steam shovel."

If Hazen's University Mound figures, applied to the Central Reservoir quantities, resulted in a cost of 5.8% below its actual cost, how inadequate must Dockweiler's University Mound figures be when applied to the Central Reservoir construction,—when the latter's total allowance for excavation and embankment amounted to but 36c per cubic yard (excavation 26c, embankment 10c), as against Hazen's 65c (excavation 40c, embankment 25c). This is but another example of the danger of Dockweiler's method of estimating, to-wit, taking certain low figures out of an estimate, without allowance for other contingent costs which increased the final cost, and without making corresponding allowance, in the work under estimate, for other items which would tend to swell its ultimate cost.

It remains only to add that Hazen's assumptions with regard to the quantities involved in the Central Reservoir construction were confirmed by its chief engineer, George Wilhelm (7443).

Potrero Heights Reservoir Excavation:

Hazen and Elliott allowed $1.50 per cubic yard for this excavation; Dockweiler 50c and $1.10, averaging 65c per cubic yard; Dillman 50c per cubic yard.

The issue between the engineers was over the classification and character of the rock, which was defined in the inventory as "loose rock."

Hazen stated that he had examined the material carefully; that it was not loose rock in the sense that it could be excavated with the use of the pick, without the use of powder, but that it was as hard, compact and solid a rock as found anywhere on the San Francisco Peninsula, though it was not as hard as the rocks found in the Sierras and other places; moreover, the excavation had to be made carefully, shooting with small charges to avoid shaking to pieces the rock outside of the excavation; the necessity

of excavating in this way added quite a little to the expense of the handling; it was expensive for the second reason, that the excavation was from a hole from which the material had to be hoisted instead of being shoveled off of an embankment or being taken off on grade (7142, 7300-1).

Elliott (7301), referring to the classification of materials made by Ransom and himself, which appeared in the agreed inventory, stated that the term "loose rock" simply meant that the rock was not one solid mass of rock, but that there were various grades of loose rock, and that they had in mind, in making their general classification, that the various men who appraise the work would naturally visit the ground; obviously a most necessary and reasonable assumption, as was suggested by your Honor (7212) in the discussion of the Lake Honda inventoried classification of materials.

Dockweiler thought the rock a soft one, though he admitted the necessity of blasting a portion of the rock, and upon the latter, which he estimated as constituting about 21% of the entire amount, he allowed $1.10 per cubic yard; upon the remaining 79% 50c per cubic yard, though the ground for his segregation was not given by him, nor is there any apparent indication upon the ground which would justify such a division. The average figure used by him was 65c per cubic yard.

It is significant to compare this figure with his allowance for excavation on flume benches, with reference to which he allowed 50c per cubic yard for loose rock, and 75c per cubic yard for solid rock. It is obvious that the cost of excavating material from a hole, raising it a considerable height, and then carrying it a distance for disposal, is considerably greater than for excavating material for a flume bench which may be simply thrown down hill (7259, 7302).

Dillman says that he could not see the excavation there, though as a matter of fact the character of the rock is clearly indicated by the streets cut through the hilltop immediately adjacent to the

reservoir; and that there is nothing thereabouts to indicate that an excavation of that size would get into a classification higher than loose rock. He says he did not want to be understood as testifying to the fact that there was no solid rock in that excavation, but he did want to state that there is no indication of it, and that he has, therefore, accepted the inventory classification as correct, and has fixed his figure at 50c per cubic yard, on the basis of loose rock. He says further that earth excavation ordinarily shades into loose rock, the demarkation not being well defined (7222).

It is significant also in Dillman's case to note that he allowed the same figure, 50c per cubic yard, for flume bench excavation, clearly a much less difficult kind of work than was here involved.

In the discussion upon the cost of excavation, Hazen again adverted to the objection to Dockweiler's method of singling out certain items of cost as a basis for estimating, instead of using the final records of total cost.

(7264) "MR. HAZEN: A. I think I had some local data which I did not mention in my testimony, and which perhaps I should have done. I had among other things the cost of the tanks and reservoirs built by the city of San Francisco (7265) for the high service system, and I considered that as one of the things. I did not resolve it directly as you speak of it, but the general fact of what they had done and the amounts they paid was one of the things that influenced my judgment somewhat as to the reasonableness of the figures which I reached.

"MR SEARLS: Q. You had that data at the time you made your appraisal. A. Yes, I did.

"Q. That was obtained from the city engineer. A. It was obtained from the city records through Mr. Behan, Secretary of the Spring Valley Water Company.

"Q. Is that the same data that Mr. Dockweiler used yesterday?

"A. No, it is not.

"Q. Did it refer to the same reservoir. A. It refers to the same reservoir.

"Q. Do the figures differ? A. It is a different kind of data. Mr. Dockweiler as I understand it, has some records which some inspector made up which the inspector thinks represents the cost of the contractor on certain parts of the work. The data that I had represents the actual payment of the city on account of the structures; the two things are not comparable.

"Q. Does your data show the analysis, so that you could exactly allocate to each structure the proper amount of these payments, or does it show the gross payments?

"A. It shows the gross payments. I was not able to make the separation with the data I had, but what I did do was to compare the cost of the finished work with the estimated cost of the reproduction of the finished work of the Spring Valley system, taking into account the differences that there are, and that, I may say, is a common way in my practice of estimating reservoirs. I am in the habit of thinking of the fair cost of a reservoir at so much per million gallons (7266), taking into account the peculiarities of the site and the local conditions of the construction, and while that is not a precise way of getting at it, as a broad general check it is exceedingly helpful."

We submit that enough has been said to indicate the inadequacy of Dockweiler's and Dillman's estimate of the cost of excavation and embankment work upon the reservoirs.

Puddle:

The subject of puddle embankment has also been fully covered and we think that it was clearly shown that Hazen was the only one of the witnesses who has had substantial experience in such work.

While the defendants' engineers claimed that good puddling material was to be had in the immediate vicinity of certain of the reservoirs, such as the Honda reservoir, they have not, up to this

time, shown to the court or to the plaintiff's engineers any such available material, although they were asked to do so. We think, therefore, that the estimates of the plaintiff's engineers upon the puddled embankment should stand.

Masonry:

The masonry estimates of Hazen and Dillman are so close as to make detailed discussion thereon unnecessary, Dillman's figures being but $13,214 less than Hazen's, which amounted to $329,000, approximately, upon all of the reservoirs. Dockweiler's figures were obviously inadequate, and will not be further referred to.

Miscellaneous Items:

Hazen's estimate upon the miscellaneous items upon all of the reservoirs amounted in the aggregate to the approximate sum of $172,000; Dockweiler's figure being $17,356, and Dillman's $31,514, less than Hazen's.

This subject does not lend itself to a ready discussion, but it is one clearly dependent, perhaps more than the other items involved, upon the breadth of experience of the engineer, inasmuch as it deals in considerable measure with small and annoying items of work. The relative experience of the witnesses in such work, should, therefore, control.

In concluding the discussion upon the city reservoirs, it may be said that by far the greatest item of difference lies in the cost of excavation, upon which the defendants' engineers' estimates are very inadequate, by reason of their failure to post themselves thoroughly as to the actual character of the material and the historic evidence to be had concerning the original difficulties of construction. If correction be made for these oversights, the figures of the defendants' engineers would closely approximate those of the plaintiff.

19. City Distribution Pipe System.

The Major Group Schedule shows the following comparative estimates by Hazen, Dockweiler and Dillman, together with the

agreed figures covered by Joint Exhibit 136. I now present Table 57.

Table 57.

	Hazen	Dockweiler	Dillman	Joint Exhibit
a Screw Pipe	$189,913	$146,713	$142,743	$140,000
b Cast Iron Pipe	4,048,411	3,772,989	4,041,583	4,013,000
c Wrought Iron Pipe	502,224	327,299	344,803	.....
d Existing Pavements	1,391,850	977,893	1,392,531	1,319,000
e Tunnels	11,966	7,556	6,434	.....
f Pipe in Tunnels	24,459	15,269	14,757	.....
g Trestles	9,098	9,518	8,904	9,000
h Cast-Iron Pipe on Trestles	Included in	C. I. Pipe above.		
i Wrought Iron Pipe on Trestles	15,405	9,441	9,183	.....
j Gate Valves and Boxes (C. I. Pipe)	130,276	173,790	160,703	148,000
k Gate Valves and Boxes (W. I. Pipe)	6,565	7,775	7,650	7,220
l Stop Cocks and Boxes	2,057	2,197	1,444	2,000
m Check Valves and Boxes	3,386	1,895	1,712	2,600
n Air Valves and Boxes (C. I. Pipe)	Omitted	1,559	1,470	1,400
o Air Valves and Boxes (W. I. Pipe)	Omitted	386	406	410
p Blow-offs (W. I. Pipe)	Omitted	676	1,241	1,070
q Meters	382,907	314,607	296,033	366,000
r Services	92,786	110,117	244,521	96,000
Total	$6,811,303	$5,879,680	$6,676,118	$6,105,700

Hazen	$6,257,249
Dockweiler	$5,520,115
Dillman	$6,300,941
Joint Exhibit	$6,105,700

It is to be noted that in the Joint Exhibit (No. 136) agreement was not reached upon groups "C," Wrought-Iron Pipe; "E," Tunnels; "F," Pipe in Tunnels; and "I," Wrought-Iron Pipe on Trestles. Therefore, comparison cannot be made of the footings upon the entire amount of the city distribution pipe system. Eliminating the items not covered in this Joint Exhibit, comparisons of the footings of all of the remaining items, covered by the city distribution pipe system, is as follows:

Hazen	$6,257,249.
Dockweiler	5,520,115.
Dillman	6,300,941.
Joint Exhibit	6,105,700.

20. Calaveras Dam.

In the Major Group Schedule the following estimates appear:

Hazen	$554,113.
Dockweiler	539,828.
Dillman	No estimate.

The inclusion or exclusion of this item in the structural values will depend upon the decision which your Honor may reach as to whether the expenditure upon the Calaveras dam should be included in the reproduction cost of the structures as one of the measures of value in determining the rating base, on the ground that these expenditures have all been incurred, and that therefore the investment should be recognized in the rating base as incurred; or whether, on the other hand, the expenditures should be excluded on the ground that the investment should not be assumed to have been incurred until final completion and use of the structure.

In neither case is there any issue as to the necessity for or propriety of the construction of the Calaveras dam; nor is there any claim that the structure itself is in present actual use. It is clear that equity may be done through the application of either

method, provided at the completion of the structure all the expenses which enter into its cost are recognized and allowed for. In this connection, however, the suggestion of Hazen and Metcalf cannot be ignored, and it seems to us that it should be determinative of the question raised. When the dam is completed an expenditure of millions of dollars will have been made. This fact, if allowance is not made in rates as expenditures are incurred, will necessitate raising the rates substantially when water from Calaveras is furnished. It requires no engineering knowledge, we do not really need the statements of Hazen and Metcalf, to know that the rates cannot be continually increased and decreased without discomfort and annoyance. By far the fairer method is the one which takes as a rating base a sum which will, over a period of years, represent the amount devoted to the public service. In this case in 1913 half a million dollars was devoted to the public service because it had been expended in the construction of the Calaveras dam. The benefits of that devotion were to be realized within a comparatively short period, and it is submitted that it is better policy, and a policy which this court is warranted in following, to heed that expenditure and make an allowance for it, rather than to store up for the future an increase in rates. The suggestion is fully warranted by the authorities to which we referred in our discussion of property in and out of use. There is no possible reason in this case why this court is not authorized to treat as property in use the actual cash expenditure made under the circumstances which here exist.

21. Structure Values Not Discussed in Detail in Evidence.

The Major Group Schedule shows that in the Groups 1 to 21, inclusive, all of the structural items were included, excepting the following:

Hazen	Dockweiler	Dillman
$408,665.	$344,878.	$474,192.

Of these amounts the Pleasanton Ranch houses cover respectively $170,141, $129,121, $198,792, and it is to be noted further that Dockweiler admitted later that he had erroneously omitted the valuation of the Hop Ranch buildings, which were valued by Farquharson, whose estimate Hazen took, at $8819, and by Dillman at $11,568, as appears in Plaintiff's Ex. 168a. Callaghan, defendants' witness, submitted evidence upon the present value of the Pleasanton Ranch houses (Defendants' Ex. 184) amounting to $85,030, comparable with the depreciated values of Farquharson, Dockweiler and Dillman, amounting to $132,568, $69,886 (excluding Hop Ranch buildings valued by Dillman at the gross sum of $11,568) and $85,618, respectively. Deducting the respective allowances for these ranch houses, and applying Dillman's estimate upon the Hop Ranch buildings to Dockweiler's figures, there are left the following comparative figures: Hazen, $238,524; Dockweiler, $204,189; Dillman, $275,400. Though Dillman's figures were somewhat higher, we are content to stand upon Hazen's figures, which were based, as to the buildings, upon the estimates of plaintiff's witness, D. B. Farquharson, a skilled and reputable builder of this city, as submitted in Plaintiff's Exhibit 168a, modified in a few instances principally with respect to certain of the pumping stations, upon which Farquharson did not, in all cases, estimate the foundations and based as to the other structures, covered by this item, upon his own judgment.

The comparatively small difference between the figures of plaintiff's and defendants' engineers will have to be adjusted, no doubt, by your Honor on the basis of the witnesses' experience.

We have now discussed all of the groups of items entering into the Major Group Schedule, save a few items of nominal amount, shown therein as items 24 to 30, inclusive, necessary to bring the figures of the several witnesses to a strictly comparable basis, and to make the total figures resulting comparable with the detailed inventoried values submitted by these witnesses.

The total comparable figures of the several witnesses shown in item 31 of the Major Group Schedule, should be modified by the correction shown below, and referred to in the text of the argument, to make them in accord with the witnesses' final statements.

I now present Table 58.

Table 58.

	Hazen	Dockweiler	Dillman
31. Grand totals, excluding overhead and interest-during-construction and stock-on-hand	$19,501,694	$15,449,545	$15,892,512
Corrections:			
(a) Lead Submarine Pipes	—3,500	+5,299	.....
(b) Duplication flume lumber, included both on "flumes" and "stock-on-hand"	—2,116	.....	—960
(c) Elimination "Boats" in Crystal Springs Dam, included in operating expense	—1,900	.....	—1,243
(d) Correction covering transposed quantities "Grouting" Crystal Springs Dam	—3,026	.....	.....
(e) Elimination paving over supply mains under "Riveted Pipes outside city"	—31,751	—21,774	—32,400
(f) Elimination "Clay Dam" from "Earth Dams and Flumes"	—12,522	—7,711	—6,948
(g) Deduction covering substitution of pavements "actually cut" for "all pavements"	—1,168,850	—754,893	—1,169,531
(h) Corrections covering agreements in Joint Exh	—193,709	+260,683	—107,799
Sub-totals items (a) to (h)	—$1,417,374	—$518,396	—$1,318,881
32. Revised Grand Totals excluding overhead and interest-during-construction and stock-on-hand	$18,084,320	$14,931,149	$14,573,631

OVERHEAD.

We now come to one of the most important subjects for discussion in this case, that of overhead costs, and interest-during-construction. We shall consider overhead allowances first.

We have searched the text-books and the cases for a concise and accurate description of this allowance, the propriety of including which is conceded, but we have found no discussion comparable with that of Hazen, which commences at page 7610 of the record. We quote fully from it because it is of the utmost importance to have clearly in mind what is included and what is excluded in these particular charges:

(7610) "When an engineer makes an estimate of the cost of building, or the cost of reproducing a structure or a system, it is the common practice, after writing down the estimates that are made for the several items, to add a percentage at the end. There is no uniformity in custom as to what this percentage should include. It is a very common procedure for one making an estimate for work to be constructed, when he goes over the estimate that has been made, to take into account in a general way the thoroughness of the estimate; by that I mean its completeness with reference to all the details, and the adequacy of the prices, and to correct in a measure for what is conceived to be the deficiency or surplus in the estimate by increasing or decreasing the per cent added at the end. That accounts, oftentimes, for variations in the percentages that are made in estimates that are otherwise similar. Very commonly the percentage that has been added has been referred to as engineering and contingencies, and has been intended to cover the engineering and contingencies; contingencies have been understood to mean items omitted accidentally from the schedule, or any items that might overrun the estimated quantities, or unexpected difficulties of any kind that involve expenditures that are to be paid in the prosecution of the work. The allowance for contingencies in this case, I have intended to put in my unit prices

throughout, to include them in the bulk of the schedules, so that there will be no contingencies left for the present to be added at the end. I have done that for a number of reasons: (7611) Among them, that when work is done it is very difficult to separate the contingencies of a constructional nature from the rest of the construction; and as a matter of fact, they are not. and cannot be adequately separated.

"They may be estimated in advance, but when the work is done, the contingencies become a part of the work, and the total record of costs includes them; and for the further reason that I have been able to get the records of the cost of engineering and of administration for the construction of a number of water-works systems, and those figures seem to me applicable in this case. These figures are such that all the contingencies are, or must be arranged in classification in the construction costs. So that I think for this case it was best, and that was the plan that I adopted to reflect all the contingencies into the unit prices, and as I am not going to say anything about them further in the overhead, I thought it might be proper to say a few words in regard to contingencies, and their relation to the estimates that I have made for the various items.

"As far as the estimates of the unit prices that I have used in this schedule are based upon, directly or indirectly, the records of completed work made up after all the bills are paid, the contingencies that were actually met in those pieces of work are reflected and included in the prices derived from them. To take a specific case, that would apply to the Central Reservoir discussion we had the other day, taking the figure that was reported as the cost of the finished work, and finding the yardage, and dividing the cost of the finished work by the yardage. All the contingencies that were met in that work are included in the unit price that is derived by that procedure. On the other hand, as far as contract prices have been used, or quotations, and they have been used by all of us (7612) more or less, they ordinarily

do not reflect contingencies, and some addition would appropriately be made to all unit prices so far as they were deduced from that kind of data. The additional that would have to be made to cover extra work of various kinds, and unexpected losses that the contractor would have to pay, would vary from perhaps 2 or 3 per cent for the kinds of work that presented the least risk up to— well, it is hard to set that upper limit, they might be very large, indeed, on one small part of the work, but taking it altogether, I should think that as far as our unit prices depend on the contract prices, unchecked by final records of the cost of the work, that an average addition of perhaps 3 to 5 per cent should be made to cover contingencies. It has been my intention to have unit prices sufficient to cover that as far as they are derived from that kind of data.

"I am explaining this in a little detail, because the practice has not been uniform in regard to these things; it has not been uniform in my own practice. I have made different additions in different cases, according to what I believed was fair under the circumstances. So, therefore, I want to define very clearly in this case just what I am doing, and just how I am doing it, and give the reasons for it as far as I can."

We understand that the city concedes that an allowance such as that just discussed by Hazen should be made. The only controversy which can arise, therefore, is as to what it should include and in what amount it should be allowed.

As to the first question the witnesses have spoken. Hazen and Metcalf said that all the contingencies which are incidental to the work of construction, as distinguished from administrative and financial problems, are allowed for in unit prices (5511). Dillman stated that while his fair contract prices were intended to cover contingencies—the contractor's profit including contingencies—he nevertheless added 2½%. Dockweiler states that he, too, made an allowance for contingencies in his unit prices as he went along. All the witnesses stated that they intended

to include preliminary engineering expense, engineering during construction, general administration, insurance and taxes during construction. The allowances made by the various engineers were as follows: Metcalf and Hazen, 15%; Dockweiler, 11%; Dillman, 10%. Which of these figures should be taken? There is no point in this case where your Honor must more carefully weigh the scientific equipment, the experience and intellectual honesty of the several witnesses than here. In this instance, the final result is entirely a matter of judgment. Other work of construction will necessarily be a guide, but the costs of such work, never the same as that in hand, requires for its proper use an interpretation by a skilled and honest engineer. It serves as a check, it can never take the place of actual experience.

Furthermore, we have one genuine difficulty to face. The allowance determined upon must be reached with a full appreciation of the figures to which it is to be applied. Just as the estimate of one engineer for overhead cannot be added to the costs of another without a careful consideration of fundamental methods of appraisal employed by each, so Hazen's overhead cannot, for instance, be fairly applied to Dillman's cost of riveted pipe. It is not the valuation of a separate property element, it is in effect a part of unit costs, and it must be viewed in that light. Hazen's figures for Crystal Springs dam are not his basic costs, plus such an allowance for overhead as some other engineer may consider proper.

We shall now turn to the testimony. We shall take up, first, Hazen's figures. They were based primarily upon a breadth of personal experience and the knowledge derived from it. He knew the problem because he had faced it before, not in theory, but in practice. He had actual cost records. From these he selected four which gave the history of four plants sufficiently similar in important respects to serve as a fair comparison in this case. Of these he said (7616):

"These relate to systems constructed by public corporations,

that is, by cities, or in one instance by a metropolitan water board, which is in reality the Department of the Commonwealth of Massachusetts. I have used this data because it was the best and most applicable that I had, and because I have no corresponding data relating to privately owned waterworks systems. At least three-fourths of all the large waterworks systems in the United States are now in public ownership. I have been employed by both companies and municipalities in preliminary work, and in the design and construction of works. The methods employed in handling the engineering of waterworks construction (7617) vary greatly, but they vary more between different municipalities and between different companies, than they do between companies as a class and between municipalities as a class. I am confining what I have to say to those cases where the work was done in my judgment properly, and economically and well, and excluding all the cases where outside influences were strong, and limiting it in that way, it is my judgment that the engineering work and the construction work, as done for corporations, and as done for cities, is comparable. I do not know of any substantial difference in the methods or in the cost that would probably be involved, so I think this comparison of municipal works may fairly be applied. It may be necessary to keep some things in mind, and perhaps to make some small allowances, but generally, I think it is a fair basis, and it is the best one that is available to me."

* * * * * * *

"A great deal of the work done in the country has been done under inadequate or incompetent administration and supervision, and the costs have been too high. In a general way I should say there has been too little engineering, meaning by 'too little' not necessarily too few men, but too little skill, and that has very frequently resulted in bad designs that involve additional cost; it has resulted in the use of poorer materials, for in almost all the materials of construction there is more than one grade,

and sometimes a great many grades, and unless one is skillful, and knows what is wanted, and what can be secured, it often happens that the price is paid for the proper material, and a poorer one actually goes into the work. Then the effect of too little engineering is reflected in extra work and in greater contingencies; as the engineering is poorer the contingencies increase (7619). Finally, it resolves in the failure to reach the desired result. It has occasionally happened in American waterworks history that works have been built at large expense, and when they have been finished, for some reason that was not anticipated, by failure to make proper investigation, the works have failed to fulfill their purpose, and other works have been necessary to follow up and produce the desired results. So, the engineering business has not been standardized, and there is a very wide range in what has actually been done; there has been a wide range in the costs of engineering that have been actually incurred in different works, and to compare the costs of engineering as a percentage which actually has been paid on miscellaneous systems without knowing how well the works were built, and how well they were carried out, does not mean very much to me.

"The engineering of the Spring Valley system shows remarkable skill and continuity of purpose. The materials employed in construction have been good in quality, have been very well arranged to give the maximum service. To illustrate, I think any engineer would find it a very puzzling problem to take 21,000 tons of iron and form it into a system of pipes that would bring over 40,000,000 gallons of water from the source of the Spring Valley Water Company into San Francisco, and deliver it year in and year out through a long series of years without important interruption by accident. It involves close, hard study, and if the problem was to be attempted by a great many good engineers, I am sure that many of them would find it necessary to use a good deal more material than is in this system to secure the desired result. The works have been built for long life.

If they had not been, the supply could (7620) not be maintained with the works as they now stand; and further, they were built with reference to future use as well as present needs. It rarely happens that an old system like this is found, where there is so little of the material now in use, that apparently will be discarded in the connection with the development of the city to supply a larger population and increasing future needs.

"The Spring Valley system is a great deal more valuable because the engineering has been carried out in this way, and it seems to me that the work in this system is fairly comparable to that that has been done in some of the best eastern systems of waterworks, for which I am presenting statistics in this exhibit.

(7804) "One reason I selected these four plants, was because the work was done by an independent commission, and there was no mixing up of their accounts with the general city accounts. That I consider very important, because, from my experience in doing work with cities, it is very rare, indeed, to be able to get all the accounts when one gets through, so that one can tell the whole cost of the work; cities do not keep their accounts so that that can be determined.

(Ab. 2196; Tr. 7805) "It seems to me that, taking the work right through, the New York work, and the work that would be involved in reconstructing Spring Valley plant, is a pretty fair comparison; that the difficulties in one case, as far as I can tell, are proportional to those in the other. It seems to me that a comparison from one waterworks system, including all the classes of structures that go to make it up, is much more to the point, than a comparison drawn from other kinds of engineering structures, for instance, railroads or subways. I don't know anything about those, and I don't know whether the engineering is the same or not; I have had no experience, and I should not give statistics of that kind much weight. I would look for waterworks systems. In general, it is true that the special difficulties in one situation will not be the same as the special

difficulties in another. If they were the same, the business would be standardized, and on a very different basis from what it is."

The details of the comparison referred to in the foregoing quotations are in the record at pages 7619-20, 7804-5, and in Pl. Exh. 155.

The witness was then asked to segregate the total allowance of 15% into separate items. Observe the candor of his answer (7779): "They will vary in every job that is carried out, and as long as I have based this statement on actual experience and actual experience solely, and in my judgment representative experience and comparative experience, it seemed to me that the total was more significant than the division. The figures which I presented do show the divisions, in part at least, for the cost that I cited; those figures speak for themselves. I might have considered some distribution of this overhead among the various elements which are ordinarily classified separately, but I do not think it is any better way, or as good a way as the way I used, and I actually did not do it."

He was asked as to the engineering organization of complainant under Mr. Schussler and its ability to handle the reconstruction of the Spring Valley plant. To this question he replied:

"The Spring Valley works, I have said in my direct examination, were very well engineered. I did not make any special study of the organization which was actually used by Mr. Schussler in constructing the main units of these works. I should not say that a very elaborate engineering organization would be necessary in a reconstruction of the works as they stand today, because I do not think a very elaborate engineering organization has (7780) been had on the works that I have cited, but the organization certainly would more nearly be comparable to that used on the work that I mentioned than to the organization that was used by Mr. Schussler; that would be necessary because these works would be built in a limited time. Mr. Schussler worked on the development of the Spring Valley system for a lifetime, and Mr.

Schussler, and the organization he had, in my judgment, would be wholly unable to handle all the work involved in the construction of this system in a period of five or six years."

* * * * * * * *

"The engineering ordinarily means the technical control of the work, and that affects everything else. * * * * It affects the unit prices; it affects the quantity of materials; it affects the excellence of design; it affects the quality of materials, and it affects the extras and contingencies; it affects everything. If we take the engineering on (7782) the Spring Valley work as 10%, and you have a certain result, and supposing you try to cut our engineering outlay in half, what is the result? Instead of spending $100 on construction, you might spend $120 or $130, or $150. In other words, you would build structures not well adapted; you will have more unit quantities; the unit prices may be more or less, because with poorer engineering there might be less good quality, and there might be a cutting of prices to correspond with it. I should expect, with cheaper engineering, that you would have poorer structures, and that they would cost more. It is my inference that the Spring Valley structures, as they stand today, were well engineered, and as far as I know, the engineering was done principally by local men here."

As to the possibility of using present administrative organization for the construction of the reproduced plant he said (Ab. 2194; Tr. 7799):

"I am somewhat familiar with the present administration of the Spring Valley Water Company. I don't think the present general organization of the Spring Valley would be sufficient to handle the construction of a system of this kind in a few years. As to what departments of general administration would be increased most is getting down into pretty small particulars. I don't know that I can tell you right off. There would be a great many things to be considered. The engineers have to be selected and looked after; that is the greatest responsibility of the administration, and

it is a great responsibility. Then, the policy with regard to acquiring land and rights, what shall be done, discussion by the engineers of all matters that come up, the negotiations with the public and the corporations that are met in connection with the work; it would certainly involve an amount of business for which there is no comparison in the present Spring Valley organization."

The witness further took up with Lippincott the overhead costs of the Los Angeles aqueduct. Those he found to be 13.7%. The basis upon which these figures were computed is found in Exhibit 138. Lippincott was not prepared to and did not testify upon the subject of general overhead, but he stated that to his valuation of the Crystal Springs dam a percentage for overhead should be added and that he thought it might be 13%. This remark must not be confused with an estimate upon the entire work which involves, of course, an entirely different problem, different primarily because overhead on large single structures is different from that on small ones.

For Hazen's figures we may fairly assert, first, that they come from an engineer of acknowledged ability and experience; and second, that they are supported by the history of every other plant in any way comparable to which reference was made in this case.

Metcalf was the next witness to testify on this subject. Of the interconnection between unit cost and overhead, he says (Ab. 2138; Tr. 7650):

"When I began work on this problem I had anticipated that I should make an estimate of the reproduction cost of the property, and at that time I gave consideration to the question of the overhead costs and the interest during construction charges, which may well be incurred during the reproduction of such works as these. I have the feeling that the two subjects, the consideration of the unit costs to be used, and the overhead and interest during construction charges are closely interdependent, and that the two must be considered collaterally. I can illustrate best

perhaps by saying that the character of the preliminary studies, the thoroughness with which the studies are made for the construction of large works will have an important effect upon the contract figures which may be obtained under competitive bidding upon those plans. Also because the element of uncertainty on the part of the contractor who is bidding will be reduced to a minimum. Furthermore, the element of the time of construction enters very largely into a consideration of those unit costs, for if it be assumed that the work must be done under rush conditions, the cost may be substantially enhanced thereby.

"I have assumed and I understand that Mr. Hazen assumed that the work would be carried on as to time allowance under such conditions as might lead to the cheapest ultimate cost of the work, including not only the unit costs making up the basic cost of the structural plant, but also the overhead charges and interest during construction allowance, which might result or which ought to be added."

Metcalf then refers to the different classes of items which are sometimes claimed to be overhead costs:

(1) Preliminary expenses, organization and promotion: Your Honor suggested while the latter item was under discussion that promotion should perhaps be ignored in this proceeding. Mr. Hazen made no allowance for it, saying (7778):

"As far as that 15% is concerned and the question whether that includes any promotion or organization expenses, I think the figures that I have fully substantiate the 15%. I think they would substantiate a figure a little higher than that without any allowance for promotion and organization expenses. I should say that 15% might fairly be considered as excluding that. I really do not know what those expenses would run, or what ought to be allowed. I think it is a fair statement that I have practically disregarded that when I made up the estimates. The preliminary engineering investigation I intended to include. I am in a position to include this because I have had a great deal of

experience with that, and know what it involved, and what is often spent."

Metcalf stated that, on his estimate, it would be less than one-half of 1 per cent. If we understand correctly the meaning of the term "promotion," namely, the expense paid the individual or group of individuals who initiate the undertaking and secure the co-operation of responsible supporters, it seems to us vital to the general theory of reproduction. It is just as necessary a charge as interest during construction, and has been so recognized by some, if not all of the commissions. Its allowance has been definitely approved by the New York and Wisconsin commissions.

Metcalf then takes up: (2) engineering and supervision; (3) legal expenses; (4) administration; (5) discount and financial costs which, he states, are not included here and should be allowed for in rate of return; (6) contingencies which, as we have said, are not included except those of an administrative or financial nature; (7) taxes during construction.

We commend this discussion to your Honor (7660) as being a very clear statement of what the different items include and what the final allowance covers.

Like Hazen, Metcalf reached the figure of 15% on an entirely independent investigation and then turned to the histories of other companies as a check upon his estimate. These investigations are shown in Exhibit 156 in accessible form. He thus summarizes his work (Ab. 2152; Tr. 7679):

"I have made no direct application of these figures. I have summed the matter up finally as a matter of judgment, bearing in mind these figures which I have worked up from time to time, and the experience which I have had in construction matters, so that they have been used as an aid to judgment, without any direct attempt to apply each one of the items given here. The size of the plant has an influence on the amount of the allowance; it affects various items, more particularly the interest during construction allowance growing out of the longer period required to

build the works, which results in heavier interest during construction charges upon the money invested in the plant before the plant is actually put into operation. In the matter of the engineering costs, there is considerable variation, depending upon the care with which the investigations are made. If the engineering problems involved are worked up in detail before the execution of the contracts, the engineering expenses are, of course (7680), substantially heavier than if the work is done in a rougher kind of way and then executed by day labor, making possible the changing of plans as work goes on, and perhaps not making such detailed plans as would be necessary were the work let by contract. While that would result in greater engineering cost, I think generally it results in a lessened final cost of the work. It is also true that on smaller work the engineering costs as stated in a percentage of the cost of the work is smaller than in the case of the larger work. That, in general, is true of the overhead costs. That reflects again the time element involved in preparing for the work and the early stages incident to the construction work."

* * *

(Ab. 2202-3; Tr. 7820):

"I have not attempted to segregate my 15% for general overhead in detail. I can show to you, in a general way, that the preliminary expenses of organization, incorporation, promotion, and the legal expenses, and engineering expenses that might be attached to that (7821), and I should estimate that at approximately 1% on work of this magnitude; on very small work I have seen records which have run from 3% to 5%. On larger work the percentage would be smaller. In a general way, I should say that the engineering and general administration would be perhaps from 10% to 12%. It depends so much upon the method of accounting which you use, that I do not feel as if I knew just what the amount of the engineering, as distinguished from engineering expense, was in the records, examples of which I have given

you. In some cases one system of accounting would include the costs incident to the engineering work in miscellaneous expenses; in other cases all of those costs are included under the engineering itself; so it is exceedingly difficult to get an absolute line by comparison between the two. I should say that probably the administration might run from 3% to 5%, depending upon the method of accounting, as to miscellaneous expenditures; and the engineering from 7% to 9% on the same basis; in other words, it becomes a question as to where you draw the line on your clerk hire, and the expenses of your office, the telephone system, the rent, automobiles, and all that sort of thing. In the examples I have given, I am not sure which method was used in each so as to be able to separate them. I cannot draw a sharp distinction (7822) in the method of accounting. I know it has been different in certain cases. In general, I should say on the preliminary work it would be 1%; on the taxes, perhaps 1%; on engineering and administration, perhaps about 12%, leaving the miscellaneous 1%; on the other hand, that would require the assumption that in the engineering and administration had been included some expenses which might have been included under other systems of accounting in the miscellaneous expense.

"With Mr. Sharon's assistance, I tried to get a line on those costs in the Spring Valley construction, but we were unable to do it. I cannot say that there was anything which indicated that engineering expenses were very high, or very low, or moderate, in proportion to other large construction with which I am familiar. It is my impression that they were moderate."

We thus have the opinion of two witnesses, supported by the actual experience of comparable water properties. It is noticeable that in each instance emphasis is laid upon the fact that the estimate is made upon the assumption that the work would be done "under such conditons as might lead to the cheapest ultimate cost, including not only unit costs, but the overhead charges and interest during construction allowance"; that the units would

be designed and constructed so as to produce the maximum efficiency of both the engineering and administrative departments and that any method of construction which was not designed along these lines would result in a different and larger overhead allowance.

Let us now turn to the city's witnesses.

Dockweiler's testimony upon this subject is very brief. It is based upon no personal experience, for he has had none. He simply says "my total overhead comes to 21.9% which includes interest during construction," and segregates it as follows:

TABLE 59.

	Including Interest during Construction.
Administration	3 %
Engineering	7 %
Insurance	1 %
Interest during construction	9.9%
Taxes	1 %
Total	21.9%

Referring to administration, he says:

(Ab. 2183; Tr. 7764) "Taking up general administration, on the first page of my memorandum: this is an allowance made on my judgment, and it amounts approximately to $450,000."

Of the insurance allowance, he says:

(Ab. 2183; Tr. 7764-5) "The insurance I took at 1%; that amounted to about $150,000, which is the insurance that a company, in my judgment, ought to have to protect itself generally; that is purely an estimate. I have not any details or studies of why I allowed it, but I put it in, and in my judgment it is a reasonable figure. That does not include insurance paid by the contractor. This is separate for the company to protect its own property."

No reason for the 1% allowance for taxes is given.

Referring to the engineering charges, Dockweiler cites two examples; the first, the Los Angeles aqueduct, shows on his figures 7.7%, but this, it so happens, is one of the items entering into the figure discussed by Hazen and Lippincott, 13.7%, and their figure, covering the entire item, is clearly more reliable than a segregation which confessedly is not complete. As to the city work in San Francisco, on which Dockweiler reports 7.4% for engineering, it comes within the limits named by Metcalf (7821); we have no quarrel with either figure. The latter information is, however, of slight help because we do not know the total overhead on the job. Dockweiler covers five items; as to no one of the five has he any knowledge gained from personal experience. As to one he has information furnished to him by the others which appears to be reasonable.

Is there anything in this testimony which should lead your Honor to accept his 11% as against Hazen's and Metcalf's 15? We think not.

Dockweiler has, himeslf, supplied the reason for this conclusion. At page 4231 he said:

"Q. If you exclude the information which you derive by examining records of corporations, have you any knowledge or information whatever of the question of overhead?

"A. Other than the instances cited, no.

"Q. What instances are they?

"A. I have stated them.

"Q. You mean these Los Angeles experiences?

"A. Yes, and then I have a knowledge of overhead such as has been set forth in statements of various corporations and——

"Q. I asked you to leave those out of consideration.

"A. Then I have not any.

"Q. You haven't any.

"A. No.

"Q. In other words, you have never done any work of any kind except these small pieces of work in Los Angeles, 18 or 20 years ago, that will enable you to determine what the proper allowance for overhead is?

"A. Personally, no; well, I have had a little overhead on this pumping station over here."—That is the Orphanage Home at San Rafael.

Observe, however, that Dockweiler's estimate excludes all allowance for any contingencies of any character. He might consistently have included in his unit costs all contingencies incident to actual construction, that is what Hazen and Metcalf did. He could not reckon the contingencies of administration and financing, however, in his unit costs. He forgot that.

Most important, however, is his failure to consider the effect which his method of construction would have on overhead, the increased costs from unbalanced work and the unheard-of method of construction which he suggests. We shall have occasion to refer to this subject again when we discuss going concern.

We now turn to Dillman's testimony. As to his experience with problems of this kind, he says:

(Ab. 2207; Tr. 7835) "I am not very well acquainted with large enterprises of this kind. My large enterprises that I know about are railroads."

Again he says:

(7848) "Q. What experience have you had, Mr. Dillman, in doing the preliminary work for such an enterprise as this?

"A. Well, I do not mind saying now that the principals are gone and they cannot be affected, that I did spend considerable time in making investigation of the Sierra Nevada water supply for private parties; the studies went over two or three years, and my determination then was that the best Sierra Nevada water supply for the city of San Francisco was from Lake Tahoe.

"Q. Mr. Dillman, what I am asking you about was what

experience you have had with reference to any property that has subsequently developed?

"A. I think I have made none for a large supply."

And again:

(7857) "I have some records of overhead which are not mine. I have no records of my own construction showing overhead, because I have no records of my own construction anywhere."

The witness makes the following allowance: (I now introduce Table No. 60.)

TABLE 60.

	Excluding Interest during Construction.
Preliminary expenses	0.1%
General expenses	1.0%
Engineering	5.0%
Taxes and insurance	0.5%
Contingencies	2.5%
Total	9.1%

He refers to no other work of construction and has no figures taken from actual experience. He refers to two text books, one of which deals with the overhead on the New York subway, the other on railroads. It is pertinent to here remark how often Dillman shows the absence of waterworks experience by attempting to measure the value of such properties through resort to railroad construction figures—a course which Hazen so vigorously condemns. Even his elastic and statistical colleague could not follow Dillman here. His estimate is so apparently inadequate as to general administration, engineering and preliminary expense that we shall not discuss it further.

One other interesting piece of information should be noted, and that is the overhead on Calaveras dam so far as it was built

at the end of 1915. Metcalf went into this and showed in Exhibit 194 that the general construction and auxiliary expenses (to employ Lippincott's methods) to 1915 amounted to $829,955; that the overhead was $181,367, or 21%; if there be taken from this overhead the early expenses of $56,575, and there is no valid reason for their exclusion, we have $124,792, or 14.9%—a rather interesting, but not of course conclusive, check upon the estimates of the company's witnesses.

In conclusion we can only say what we did at the beginning, that experience should be given the greatest weight. In that respect Hazen and Metcalf are richly equipped. Dillman and Dockweiler have had none. It is with them here as it was throughout. To follow them is to place inexperience and guessing above experience and accuracy.

INTEREST DURING CONSTRUCTION.

The nature of this allowance is clear and requires no prolonged discussion or explanation. It is conceded in principle by the city and the only question is as to the amount. The determination of this question involves the consideration of two others; first, the interest rate; second, the period of construction.

On the first point Hazen, Metcalf and Dockweiler take 6%, the latter saying (7765):

"I think the company starting in would not have as good a credit as one now, and I would say money would cost them 6%."

Dillman adopts 5%, but in the light of his cross-examination we shall not discuss his testimony. If counsel wishes to urge a 5% rate we shall be glad to hear his argument.

The only question which is left is the period and manner of construction. On this subject Hazen said (Ab. 2136; Tr. 7644):

"For the Spring Valley structures, on thinking the matter over, it seemed to me that taking it right through a period of construction of five years after the preliminaries was as short as could be counted upon, and an average interest payment for

a period of two years at 6%, making 12%, and that is the figure which I have used. So I have added to the estimate for my structures 15% for engineering and administration and 12% for interest during construction, and the 12% is reckoned on the 15% as well as the 100% in making the calculation. I adopted the 5-year unit and the 6% rate because I think that is as short a time as it would be reasonably possible to build this system, pushing the work as fast as it could possibly be pushed; in fact, I doubt if all of it could advantageously be built in so short a period, but taking into account the fact that some parts of it probably would be put in use before other parts were finished, it seemed to me that it was a fair estimate to make in this case, and in view of these figures which I found from the works which I have examined, and in view of the magnitude of the structures here, a two years' average interval for interest, in my judgment, is as short a one as could be assumed for the construction, even taking into account the idea that parts of the plant would be put in service before other parts were ready."

* * * * * * * *

"The compound figure on overhead is 28.8%. I applied it throughout the schedule. Some people make separations (Ab. 2137; Tr. 7644), put more on one structure than on another; it seems to me that is a matter of speculation. I have no basis for doing that, and it seemed to me safer to take the figures from experience representing the whole condition and to apply them in that way; obviously, the interest during construction would be much greater on some structures than others, but I have overlooked that, taking it right through."

* * * * * * * *

"I would assume, for instance, that when the Crystal Springs (Ab. 2137; Tr. 7646) water was available, that business might be started at a good deal less than the present rate of business

without waiting for the Alameda water to be brought in, which would probably take a longer time; but I have not attempted to make a construction schedule of that kind. It is not an easy matter to lay your work out theoretically so that all parts will be done just at the moment, when they are constructed. There are too many uncertainties in construction to make that plausible. It seems to me the basis of broad, general experience backed up by reliable statistics of this kind, is the proper way of getting at it, rather than substituting a schedule that one evolves out of his mind and is obviously pretty much speculative. I did not use any such schedule as a basis for my computation."

Hazen made use of the actual costs of four comparable plants, ascertained what they had paid on this item, and thus found support for his earlier opinion. We shall not discuss those costs here. They show the spirit in which the witness approached his problems. In his opinion the period of actual construction should be five years, and the interest allowance for an average of two years. The system would be put into operation unit by unit and the allowance as to each unit made by him only covers such time as would elapse prior to the commencement of operation by such unit.

Metcalf says (7733):

"Before the construction of works of magnitude can be undertaken, financial arrangements must be made for the advancement of the necessary funds. If the period of construction involved be comparatively short, such as one or two years, it has generally been found advantageous, if not necessary, to borrow the entire sum needed in advance of construction. If, on the other hand, the period of construction is a long one, such as five or ten years, it is generally found advantageous to make arrangements for the advance of stated sums during the time of construction period. Generally, bankers and underwriting syndicates prefer, however, to make arrangements on the basis of purchase of the entire

bond issue, though the bonds be delivered at stated intervals in blocks, and allowance made for repayment of a nominal rate of interest, such as 2% upon unexpended bank balances.

"Necessary financial arrangements, therefore, involve the payment during the construction period of interest upon the funds borrowed, or advanced by the owner of the property (7734). It is logical to include these interest payments in the construction costs of the property up to the time when the workable units of the plant are put into actual revenue producing operation; the interest payments involved by the investment in the unit of operating property should be accounted in development expense during the period involved in the acquisition or establishment of the business to the point where the earnings are sufficient to meet the fixed charges, as well as the operating expenses and depreciation allowances; thereafter, the interest payments should be accounted as fixed charges, to be met from the net revenue, or divisable earnings of the property.

"The determination of the exact time when the different workable units of the property may be fairly assumed to have crossed the dividing line between the 'construction period' and the 'development period' is difficult; but fortunately, this is not a matter of controlling importance, if proper allowance be made for development expense or going concern element of the value of the property."

Referring to the New York water supply, he says (7654):

"In the year 1907, after the organization had been fairly perfected and the work was well under way, there was expended something over $2,000,000. In the year 1908 there was expended four and a half million dollars. In the year 1909 there was expended $11,000,000. In the year 1910 there was expended $19,000,000. In the year 1911 there was expended $26,000,000. In the year 1912 there was expended $23,600,000. In the

year 1913 there was expended a little over $21,000,000. These figures are perhaps approximate. They were taken from the New York water supply reports. I can give them to you in greater detail covering the various structures if you wish them. They are of significance principally in showing the time element required to build up an efficient organization to get work of large magnitude under way. That work has not yet, of course, been completed, although it is nearing completion.

"Those figures are comparable with my assumption that an active period of construction approaching five years—four and a half to five years—would be required to build these works. If it were assumed that a period of four and a half years were not taken, it would, in my judgment, increase the unit prices which have been allowed on these works, because the work would be done at a disadvantage (7655), the organization would not be so perfect; the construction work would not be done under such efficient conditions growing out of the fact that the time element is very important in the developing of the best efficiency in construction. In making that statement, I include also consideration of the interest during construction allowance."

* * *

(Ab. 2141; Tr. 7655) "The question of the fair allowance for interest during construction I approached from two points of view; first, the general question of what seemed a fair allowance in view of experience elsewhere, and from what I had seen from the character of these works, and the conditions under which they would be built. From that point of view I arrived at the same figures that Mr. Hazen did, of two years' period of time, which, at a rate of 6%, would give 12%. In arriving at that figure, consideration was given to the length of time which would be (7656) required to build these works. I then investigated in somewhat greater detail such an order of procedure as might be had in the building of the works and figured the costs

approximately which might result as to the interest during construction allowance upon the theory that the various workable units of the plant would be put into revenue producing operation as soon as they could be so used. So that although I estimated that a six-year period would be required for designing and building the works, I assumed that their operation, or the operation of a portion of the property, would begin at the end of three years, and that operation and construction would be carried on collaterally during a period of three years, and that three years more thereafter, that is, after the completion of construction, would be required to develop the existing business of the company; that is, a period of six years of construction would be required, including the preliminary design, and a period of six years for the development of the business, there being an overlap of three years in these two periods of time."

He then refers to records of actual interest during construction costs upon thirty-four public service projects, and concludes:

(7735) "It will be noted that not only the magnitude, but also the character of the structure involved, and the rate of interest paid, have an important influence upon the amount the interest during construction costs.

"In general, it may be said, that the actual interest during construction costs, involved in waterworks construction in this country in late years has ranged from about 15% for the works of first magnitude, to 3%, or thereabouts, upon the smaller works, which can be built within one building season, the interest during construction rate being applied to the combined fair contract cost and overhead expenses of the works under consideration, and at the rates of interest paid for money by our cities, from 4% or less in the wealthier and larger cities, to 5% in the less resourceful and smaller."

* * *

(7736) "Reviewing the various assumptions made, and results thus obtained an allowance of 12% of gross reproduction costs based upon the unit figures, plus overhead expenses, appears reasonable."

Reverting to the assumption made by himself and Hazen that the plant would be put into operation unit by unit, and that it was impractical and contrary to actual construction to build and withhold all operation until the entire plant was built, he says:

(Ab. 274; Tr. 7738) "If you knew the exact dates at which you wanted all your structures to go into commission, you could make an assumption when to commence the different items so as to bring them all into effect on that date, but the difficulty is it becomes exceedingly speculative. In construction matters you cannot always control those conditions. Every estimate that I have ever made, based upon that sort of analysis, has underrun a fair allowance, or the actual cost of the interest during construction, when measured by the finished work, just as in this case. I believe that it would not be advisable on a large work to attempt an approximation of the date on which all of the items would go into effect, and to commence the construction of the different units accordingly. For instance, on this work, the smaller city reservoirs and the pumping stations could be built, I have assumed, within a period of one year; there are a number of the other more important structures, the construction (7739) of which would require two years; then the Crystal Springs dam, which would require a longer period of three years, or so, and then the pipe system, which would require five years. Now, if you were to make your estimate upon the basis of building all of the structures so as to have the plant ready to begin at the end of the longest period required, you would do a tremendous amount of work in the last year. You would carry a heavy investment in the pipe system in the first years without getting any return upon it, whereas, good business would dictate

building your plant in such a way as to enable you to get the largest return financially that you could at the earliest possible moment. So that you would actually begin, as is shown by my assumption here, to operate at the end of a three-year period, although the entire construction period would be six years."

* * *

(Ab. 275; Tr. 7740) "I think, where it is possible, as, for instance, where you have several different sources of supply, some nearer than others, that plants are built in stages, and in such a way as to enable you to get your revenue as rapidly as possible, and to cut down the interest charges which will result, and also to enable you to spread your work over a little longer period of years, thereby getting somewhat better efficiency in construction."

Metcalf's procedure is thus identical with Hazen's. He takes a five year construction period and carries his interest only to the time at which his different units go into service. He assumes, as does Hazen, a program of construction which will guard against the heavy losses due to hazard resulting in postponing operation of the entire plant, and likewise plans for the most efficient and economical organization he can assemble. We shall have occasion later on to revert to these facts.

Dillman assumes that (7750) "while the construction may last five, or possibly six years, that no one item of construction will drag along over three years from the time it is begun until it is in service earning revenue." And again (7753):

"The interest varies in the different cases. I think the highest interest that I have allowed is 7½%, which is reckoned on three years' construction, and the interest on the whole amount for half the time, or half the amount for the whole time."

While Dillman obviously figures on a five or six-year period of construction, he allows interest for only three years at most, and then in only isolated cases; and it is apparent that in most instances the allowance is much less, for whereas his annual rate is 5%, his total allowance is only 5.82%. His general theory

is, then, the same as Metcalf's and Hazen's, that the plant will go into operation unit by unit. If his rate were fair and his average periods of construction were fair, his method would be satisfactory, provided—and this is an important proviso—that he looked after the deficiencies in income after such units went into operation. Metcalf and Hazen do this in going concern or development expense; Dillman pays no further attention to those deficits. He does not follow Dockweiler's theory that all the taps are to be turned on on December 31, 1913, for, under his plan, the great bulk of them will be turned on two or three years before. Does he assume, not that consumers are waiting en masse on December 31, 1913, but that they are further accommodating the new plant and that they are waiting for two or three years before, and will take service on the date and to the extent that each unit is ready? Aside from the assumption, we may perhaps be permitted to add that that is not valuing the plant in 1913. Perhaps counsel in his reply will point out in the record just what the witness had in mind. In this important branch of the case we desire to emphasize the fact that Dillman's assumed average construction period of 1.16 years is too short. It is the equivalent of saying that the whole work could theoretically be done in 2.32 years. If this is so, why assume a five or six-year period?

Dockweiler assumes a five-year period and his total allowance is 9.9%, which is an average interest period allowance on the entire cost of 1.65 years. This is to be contrasted with Hazen's and Metcalf's allowance of two years. Dockweiler does not, however, proceed on Dillman's theory of construction at all. He would have the company supply no water until December 31, 1913, and then take on all its present consumers on that day. His interest allowance is intended to cover all the costs up to that date, but, of course, does not pretend to cover any hazard or risk or actual loss which would ensue were the plant or any

portion of it not ready for operation at that time. We shall discuss this assumption later. It is enough now to notice that it is radically different from Dillman's.

In conclusion we may say that the weight of evidence on this subject, as well as on the rate of return, unquestionably requires a 6% rate, and that Hazen's and Metcalf's testimony, that a two years' allowance should be made should, on the ground already assigned, be accepted.

Summary of Gross Reproduction Cost of Structures by Groups, Including Overhead and Interest During Construction and Stock on Hand.

We submit below our contention as to the fair estimate of the gross reproduction cost of the inventoried structures, based upon Hazen's figures, which have been modified only by the correction admitted by him for the lead used upon the submarine pipes ($3500); by the elimination of an item duplicating flume lumber ($2116); by the elimination of an item covering "boats" in Crystal Springs dam, chargeable to operating expenses ($1900); by the elimination of an item covering correction upon transposed figures in Crystal Springs dam "Grouting" ($3026); by the elimination for the time being of item covering "paving" over mains in "Riveted Pipe Outside of City" ($31751); by the elimination from "Earthen Dams and Flumes" of the clay dam ($12,522); by the substitution for the present of the agreed amount to cover pavements actually cut, for Hazen's figure covering all pavements ($1,168,850); and by the substitution of the agreed figures for Hazen's figures, where agreements were reached and submitted as Joint Exhibits, as shown in the Major Group Schedule ($193,709), and as heretofore discussed.

I will now present Table 61. This is a summary of structures, including the overhead allowance. In it will be found the total

Table 61

Summary of Gross Reproduction Cost of Structures by Groups including Overhead and Interest during Construction and Stock-on-Hand.

Items	Name of Structure	Hazen's New Figure			Remarks
1	Wrought Iron Pipe (outside of city)	$3,381,308	Original figure	$3,113,059	Excluding Wrought Iron Pipe included in Joint Exhibits on Pumping Stations.
			Deduct Paving over supply mains	31,751	
				$3,381,308	
2.	Earthen Dams and Flumes	1,223,435	Original figure	$1,252,586	Excluding Buildings in Joint Exhibits but including flume lumber in place ($183,000 in Joint Exhibit).
			Deduct—(6 cover agreement on lumber in flume	11,513	
			Deduct—duplication of lumber in Stock-on-Hand	2,116	
			Deduct—Clay Dam	12,522	
				$1,223,435	
3.	Tunnels	1,124,095			(Lippincott $1,100,757.)
4.	Buildings	150,000	Original figure	$152,310	Plus correction $984 at end of Major Group Schedule
			Deduct— to cover agreement to Jt. Exh. on Buildings	2,310	" " 984 " "
				$150,000	
5.	Pumping Stations (Entire System)	1,092,570	Original figure	$1,162,119	" " 4600 " "
			Deduct— to cover agreement Jt. Exh. Pumping Stations	69,549	Excluding Buildings, $82,430 in Joint Exhibits of Buildings.
				$1,092,570	Plus correction $4600 at end of Major Group Schedule.
6.	Crystal Springs Concrete Dam	1,749,250	Original figure	$1,754,176	Excluding Buildings in Joint Exhibits and Booster Pumping Station. For Lippincott's figures upon part of these structures see detailed analysis hereto attached.
			Deduct— to cover "Boats" incl. in operating exps	1,900	
			Deduct— to cover transposition of figures in Inventory upon "Grout"	3,026	
				$1,749,250	
7.	Crystal Springs Upper Dam	261,300			Excluding Buildings in Joint Exhibit
8.	Sunol Filter Beds	393,072			" " " "
9.	Sunol Filter Beds Buildings	5,423			" " " "
10.	Niles Aqueduct	93,603			
11.	Submarine Pipe	447,195	Original figure	$450,695	
			Deduct— to cover agreement upon lead for joints	3,500	
				$447,195	
12	Roads, Fences, Electric Transmission Lines and Ravenswood Wells	287,500	Original figure	$307,674	Pleasanton Ranch House Fences.
			Deduct— to cover agreement Jt. Exh. 137	20,174	
				$287,500	
13	Lake Merced	214,834			Excluding tunnels
14	Lake Merced Supply and Discharge Pipe to Pumps	103,093			
15	30" Conduit from Ocean View to Central Pumps	21,000			" "
16	Lake Honda Supply Main	109,442			
17	30" Central Pump Force Main	37,731			
18	City Reservoirs	865,817			
	Sub-total	$11,560,668			
19	**City Distribution Pipe System:**				
	(a) Screw Pipe	$140,000	Original figure	$189,913	*Deductions from or additions to Hazen's original figures were made to cover agreements in Jt. Exh. 136 City Distributing Pipe System.
			Deduct	49,913*	
				$140,000	
	(b) Cast Iron Pipe	4,013,000	Original figure	$4,048,411	
			Deduct	35,411*	
				$4,013,000	
	(c) Wrought Iron Pipe	502,224	Original figure	1,391,850	
	(d) Existing Pavements	223,000	Deduct	1,168,850	
				$223,000	
	(e) Tunnels	11,966			Excluding Bernal Tunnel (Incl. in Tunnel Schedule.)
	(f) Pipe in Tunnels	24,459			
	(g) Trestles	9,000	Original figure	$9,098	
			Deduct	98*	
				$9,000	
	(h) Cast Iron Pipe on Trestles		Incl. in C. I. Pipe above.		
	(i) W. I. Pipe on Trestles	15,405	Original figure	$130,276	
	(j) Gate Valves and Boxes (C. I. Pipe)	148,000	Add	17,724*	
				$148,000	
	(k) Gate Valves and Boxes (W. I. Pipe)	$7,220	Original figure	$6,565	
			Add	655*	
				$7,220	
	(l) Stop Cock and Boxes	2,000	Original figure	$2,057	
			Deduct	57*	
				$2,000	
	(m) Check Valves and Boxes	2,600	Original figure	$3,386	
			Deduct	786*	
				$2,600	
	(n & o) Air Valves and Boxes, C. I. and W. I. Pipe	Omitted			
	(p) Blow-offs (W. I. Pipe)	"			
	(q) Meters	366,000	Original figure	$382,907	
			Deduct	16,907*	
				$366,000	
	(r) Services	96,000	Original figure	$92,786	
			Add	3,214*	
				$96,000	
	Sub-total	$17,121,542			
	Calaveras Dam	554,113			
	Structure Values not discussed in detail evidence	408,665			This amount includes $170,141 for the Pleasanton Ranch Houses.
	Grand Total, excluding Overhead and Interest-during-construction, and Stock-on-Hand	$18,084,320			
	Add 15% Overhead	2,712,648			
	Total including Overhead	$20,796,968			
	Add 12% Interest-during-Construction	2,495,636			
	Gross Reproduction Cost incl. Overhead and Interest-during-Construction, but excluding Stock-on-Hand	$23,292,604			
	Add Stock-on-Hand Gross Reproduction Cost	401,350			Joint Exhibit No. 154, the depreciated amount being $289,940.
	Total Gross Reproduction Cost, including Overhead and Interest-during-Construction and Stock on Hand	$23,693,954			

gross reproduction cost, including overhead and interest during construction, and stock on hand, of $23,693,954.

[Table inserted opposite]

THE MASTER: Mr. Hazen's original figure before adjustment was something like $25,000,000?

MR. GREENE: Yes, it was very close to $25,000,000. Of course, the principal reason for the change was the elimination, at our request, of the paving over mains, which involved a deduction of about $1,100,000; and there were some changes in the inventory, itself, and then the admission as to the clay dam cost, which was not charged.

THE MASTER: The elimination of paving over mains is an elimination, you state, but you don't agree to it—is that the idea?

MR. GREENE: We instructed Mr. Hazen to assume, for the purposes of his appraisal, that he was not entitled to consider the cost of paving over mains where that was done prior to the time at which the pipes were laid.

THE MASTER: I understand that, but I thought you said a few moments ago that that was a doubtful item.

MR. GREENE: Yes, that is correct, your Honor; we will take that up under the subject of reproduction cost in general.

MR. SEARLS: I think your interpretation of Mr. Dillman's testimony is susceptible of two lines of reasoning, Mr. Greene, so far as the date at which he considers the plant going into use; it is not entirely clear to me whether he was talking about the history of the original plant or the plant that he was reproducing, when he said he considered the two different parts coming into use.

MR. GREENE: I think you will find on his own figures that he must have considered that, otherwise his figures are incorrect on their face. He takes a five-year period of construction with the total interest during construction as 5.8%; he must put his structures into use unit by unit, because he cannot have run over

a five-year period up to 1913 and not get a larger percentage on his own showing.

MR. SEARLS: Wouldn't the result have been just the same if he had started in, say, in 1911, with some of the structures, instead of in 1909, we will say?

MR. GREENE: That is exactly what he says he has not done. His period of construction is a five-year period, just as Mr. Hazen's and Mr. Metcalf's.

MR. SEARLS: Well, I will check that up; I don't know how you get at that conclusion.